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AUTUMNAL BREEDING IN THE TRICOLORED BLACKBIRD

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IN temperate climates most birds breed in the spring or summer. But in many resident species there is a period of active sexual behavior in the autumn, during which time the gonads may attain full breeding size and some individuals may achieve spermatogenesis (Marshall, 1952a, 1959). This is followed by a period of winter inactivity, succeeded by rapid spring recovery and breeding. There are, however, exceptions to this general picture. In some species such as the Anna's Hummingbird, *Calypte anna*, and Horned Owl, *Bubo virginianus*, the breeding period begins in the early or middle part of the winter. In others (*e.g.*, the Mourning Dove, *Zenaidura macroura*) the breeding period may extend from early spring well into the autumn without a break. The only temperate-zone species known to me that may breed throughout the year are the Rock Dove, *Columba livia*, and House Sparrow, *Passer domesticus*, in Britain (Lees, 1946; Summers-Smith, 1958), and the Red Crossbill, *Loxia curvirostra*, which has bred at all times of the year in North America (Griscom, 1937; Bailey, 1953). This may also prove to be the case in certain Australian desert birds (Keast, 1959), but this picture is as yet poorly worked out. Some of these species may even come into breeding condition while molting (Keast, 1959; Kemper, 1959).

In some species sporadic out-of-season breeding occurs. The unusually mild weather of November and December 1953, induced several species to breed in Britain (Snow, 1955), and some were successful in fledging young. Autumnal breeding regularly occurs in parts of Australia (Keast, 1958, 1959). In California, where mild temperatures prevail well into the autumn, regular autumnal breeding might be expected, but I have found references to autumnal breeding in only 11 species, although I have doubtless overlooked others. In some of

these such as the Mourning Dove (Howell, 1912); Band-tailed Pigeon, *Columba fasciata* (Willard, 1913; Abbott, 1927a; Grinnell, 1928; Jewett, 1941); Acorn Woodpecker, *Melanerpes formicivorus* (Michael, 1936); and Abert's Towhee, *Pipilo aberti* (Cardiff and Cardiff, 1950), this may merely represent delayed termination of a breeding season normally extending late into the summer as found by Pitelka (1950) on Santa Cruz Island in early September 1948. However, in other cases it appears to represent a definite second nesting period, separated from the spring breeding by molt and gonadal regression. Following violent summer rains, Gambel Quail, *Lophortyx gambelii,* bred in the fall of 1950, a year when spring rains failed in the Mojave and Colorado deserts (Macgregor and Inlay, 1951). In coastal California fall breeding has been noted in the California Thrasher, *Toxostoma redivivum* (Grinnell, 1900; Sargent, 1940; Davis, 1952; Dyer, unpubl.); Scrub Jay, *Aphelocoma coerulescens,* and California Quail, *Lophortyx californicus* (fide Mewaldt, 1959); Western Meadowlark, *Sturnella neglecta* (Abbott, 1927b); Lesser Goldfinch, *Spinus psaltria* (Sharp, 1908; Chambers, 1921; Abbott, 1927b); and House Finch, *Carpodacus mexicanus* (Smith, 1930; Howell and Burns, 1955). Some of these isolated nestings were correlated with the heavy rains of 1925 in southern California, but others did not accompany unusual climatic conditions. Thus, while the potential for autumnal breeding appears to be widespread in many Californian species, success apparently has not been great enough from those fall attempts to have given the habit selective advantage and thus to spread it through the population.

In the tropics, however, double breeding seasons, correlated with the double rainy seasons of many areas, are common (Moreau, 1950a; Miller, 1959a), although it has only recently been demonstrated that the same individuals may have two breeding periods within a year (Miller, 1959a). In other areas of the tropics single breeding seasons are the rule as in temperate regions. Such is the case in Central America (Skutch, 1950), Indonesia (Voous, 1950), and among Hawaiian (Richardson, 1957) and African sea birds (Moreau, 1950b). Year-round breeding is rare and is confined to those regions in which rainfall fluctuations are minimal (Miller, 1954).

AUTUMNAL COLONIES OF TRICOLORED BLACKBIRDS

Fall breeding was unknown in the Tricolored Blackbird, *Agelaius tricolor,* until I discovered a large breeding colony in Colusa County, California, on 16 October 1959. Search of many other areas in the Sacramento Valley revealed two additional colonies in Yuba County.

Breeding was successfully carried out in two of these colonies, but the birds in the third never progressed beyond the stage of manipulating nest material. Other areas in which breeding had occurred in spring had no fall colonies, and a general survey of the valley showed that breeding, although perhaps not confined to the two colonies I discovered, was not widespread.

Details of the unusual social organization in the Tricolored Blackbird will be given elsewhere, but it is necessary, for comparative purposes, to summarize the main features of spring breeding. Although morphologically very similar to the Red-winged Blackbird, *Agelaius phoeniceus*, the Tricolored Blackbird differs strikingly in its social organization, being the most highly colonial of North American passerines. Breeding colonies, seldom smaller than 100 nests, are sometimes as large as 100,000 to 200,000 nests. The males defend territories that average about 35 square feet, within which one to three nests are built by females. Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young. Most colonies are located in emergent aquatic vegetation, but they may be situated in trees along streams, weed patches, and even grain and alfalfa fields. From the nesting areas the adults fly as far as four miles to obtain food for the young. While the great concentration of birds in a small area is the most conspicuous feature of these colonies, the degree of synchrony among members of the colony is no less important, since, in most colonies, all the nests are built and eggs laid within the period of about one week.

The Colusa colony of October, five miles west of the city of Colusa in the heart of an extensive rice-growing district, was situated in a large duck-hunting club on which the cattails had been kept green by pumping water on them throughout the dry season. The nesting area occupied approximately 972,000 square feet, and assuming an average of one nest per 50 square feet, an estimate based on wading through most parts of the colony several times, approximately 19,500 nests were constructed. The Haskell Ranch colony of October, eight miles southeast of Marysville, was likewise located on a duck-hunting club, but here the water was supplied by runoff from the irrigated pastures that largely surrounded it. This colony occupied about 110,000 square feet, and approximately 2,150 nests were built.

The timing of major events in both colonies is shown in Table 1. In marked contrast to the synchrony of spring colonies, nest building in both autumnal colonies was protracted, especially at Colusa, and these later nestings did not solely represent growth on the periphery of the colony but were constructed throughout the colony area. Inasmuch

TABLE 1

TIMING OF EVENTS — AUTUMN COLONIES OF TRICOLORED BLACKBIRDS 1959

Event	*Duration*	
	Colusa colony	*Marysville colony*
Rainfall	18 Sept.	18 Sept.
Nest building	3 Oct. – 6 Nov.	3 Oct. – 21 Oct.
Egg laying	7 Oct. – 5 Nov.	7 Oct. – 18 Oct.
Incubation	11 Oct. – 11 Nov.	11 Oct. – 1 Nov.
Nestlings	23 Oct. – 25 Nov.	23 Oct. – 15 Nov.

as no individuals were color banded, it is not known whether these later nestings represented first attempts of new individuals or repeats of individuals having failed in their first try. However, in the Colusa colony, the number of birds involved in the breeding effort appeared to increase throughout the month of October, so that it is likely that later nestings represented, at least in part, first attempts of birds stimulated to breed by the reproductive behavior of other individuals.

In spite of the uniform density of cattail growth, particularly at Colusa, the nests were neither as densely nor as uniformly spaced as is typical of spring colonies, although there were regions of nest density in both colonies that compared favorably with that of spring. No instances of nests in actual contact were discovered. Clutch size was the same as in spring, clutches of three being most common with many of four and fewer of two. Many nests were deserted during building, but far more were deserted after the eggs had been deposited. Eggs were hatched in no more than one fourth of the nests in which they were laid. By breaking eggs in hundreds of deserted nests, I determined that desertion took place either immediately following laying or soon thereafter. No deserted eggs that were well incubated were found. The role of infertility in nest desertion is not known, but mass desertion at this particular phase of the breeding cycle may also occur in the spring when it is not due to infertility, but can be correlated with food availability in the surrounding environment.

Nestling survival was also poor in both colonies, few surviving past four days of age. In most instances only one nestling fledged per nest, but two young were fledged in at least several nests, and two nests were known to have fledged three young each. By repeated visits to both colonies during the time in which young were in the nests, I estimated that only about 50 young were fledged at the Haskell Ranch and 200–300 at Colusa. Nestling survival was poorer the first week of November, a period of very strong winds, than the following week,

TABLE 2

CLIMATIC SUMMARY, SACRAMENTO, CALIFORNIA (1905–1958)

Month	*Mean temperature °F.*	*Mean precipitation in.*	*Mean wind velocity m. p. h.*
April	58.9	1.51	9.9
May	64.0	0.70	10.4
June	70.1	0.13	11.2
September	70.5	0.24	8.8
October	63.2	0.81	7.9
November	53.8	1.82	7.6

which was calm and sunny. Since the days at this time of year are very short and the parents were forced to bring adult rather than larval insects to the nestlings, the rate at which protein could be delivered was doubtless low, and starvation is the most probable cause of the high rate of nestling mortality.

Because of the large nonbreeding populations of blackbirds of several species in the vicinity of the nesting colonies, it was difficult to determine the extent of the areas exploited for food for the young. At the Haskell Ranch food was apparently gathered only on irrigated pastures, and I had no evidence that any adults flew farther than one mile to get it. At Colusa food was gathered in the shallow water of rice fields, which had been flooded after harvesting to attract ducks. Here also the adults did not appear to fly farther than one mile.

The Sacramento Valley experiences mild spring and autumn temperatures (Table 2), although cold nights are regular in November. Autumnal precipitation is most erratic, and means are misleading. In 1959 the only rain prior to late December fell in one storm on 18–19 September (Table 3). The sky then remained nearly cloudless for the duration of the breeding period. Both colonies started 15 days after the heavy rain, a point to be discussed later.

The drastic changes in the ecology of the Sacramento Valley produced by agriculture profoundly influence all the breeding activities of the Tricolored Blackbird. The large rice-growing areas are the center of abundance of the species in the valley today. The crop is harvested in late September and early October, and normally the stubble is burned shortly thereafter. If possible, the fields are plowed and the checks reformed before the rains; they offer neither cover nor insects unless they are flooded for hunting. Autumnal conditions are equally unfavorable for breeding in the dry farming areas and the rangeland, the latter being grazed to the ground early in the summer. The annual

TABLE 3

SUMMARY OF WEATHER AT SACRAMENTO, CALIFORNIA—1959

	Temperature	
Month	*Mean temperature* °F.	*Departure from normal* °F.
April	63.8	+5.6
May	64.6	+0.6
June	74.2	+3.9
September	69.7	−0.6
October	66.3	+3.6
November	54.5	+1.4

	Precipitation	
Month	*Amount* in.	*Departure from normal* in.
April	0.21	−1.30
May	Trace	−0.70
June	0.00	−0.13
September	1.61	+1.37
October	0.00	−0.81
November	0.02	−1.80

grasses do not sprout until after the first heavy rains, and, normally, autumn and winter growth is slow, although occasionally, if early rains are followed by hot weather, there may be rapid growth and some plants may set seed. The irrigated pastures, which are restricted to certain parts of the valley, remain green and productive throughout the summer and early autumn. They and the duck-hunting areas are thus the only places in the valley capable of supporting any fall blackbird breeding.

MOLT AND GONADAL CYCLES IN THE TRICOLORED BLACKBIRD

Molt and gonadal cycles have never been studied in the Tricolored Blackbird, and our knowledge is based upon field observations and specimens collected during the fall breeding period. In the males, the feathers acquired in the postnuptial molt are strongly edged with brown, making an individual that has undergone the molt conspicuous at great distances in the field. All the males observed in the breeding colonies had undergone the normal summer molt and were breeding in the typical brown fall plumage. Fifty breeding birds that I collected had also completed the molt. Molt stage in females cannot be determined in the

field, but all of 34 breeding specimens taken in the colonies had also molted. Since males do not normally breed until they are two years old, it was not expected that immatures would be involved in the autumnal breeding, but participation by immature females was more likely. The sample of 88 birds collected contained only three immature males and one immature female. This suggests that six-month-old individuals were not involved in the breeding effort and were absent from the marsh during the day. None of the immatures had enlarged gonads, and although the female had completed her molt, the males had not. Gonads were not enlarged in any of the 35 male or 13 female Redwings collected.

Twelve nestlings were taken from nests and hand reared. The 10 that survived began their postjuvenal molt in late December, completing it in early February. They are being kept for observations on future molts and gonadal cycles.

In an attempt to determine whether any adults involved in the autumnal breeding had also bred in the spring, I sectioned ovaries from 25 females, hoping to find follicle scars indicating spring activity. Unfortunately, it has not been possible to distinguish ruptured from atretic follicles in the material sectioned, although this may be possible when a collection of ovaries made through the summer period has been obtained and studied. In any event, double breeding seems likely in view of the large number of birds involved and since large and successful colonies nested in spring close to the sites of the fall colonies. More precise information on this point is highly desirable.

FACTORS INITIATING FALL BREEDING

Perhaps because of the stimulus provided by Rowan's (1925) important experiments on the role of light in influencing reproductive cycles in birds, there is more experimental evidence for its influence on avian gonadal cycles than any other factor (Farner, 1959; Wolfson, 1959a). Most species that have been investigated have responded in some way to gross changes in the duration of photoperiod. Since no fall breeding bird has been investigated experimentally, decreasing day lengths are not known to stimulate any bird, but there is suggestive evidence that mammals (Bissonnette, 1941; Yeates, 1947) and fish (Hoover and Hubbard, 1937) do respond to decreasing photoperiod. Particularly in mammals where, because of long gestation periods or delayed implantation, mating regularly occurs in the autumn, response to decreasing day length may be widespread.

Wolfson (1959a and b) has argued that short days are necessary

before the preparatory phase of the avian testis can be completed. Since thousands of Tricolored Blackbirds came into breeding condition in September 1959, without having experienced short day lengths, it is clear that such a stimulus is not necessary to terminate a refractory period in this species, if indeed, it even has one. Wolfson has informed me that he is unable to detect any refractory period in the tropical African weaver, *Quelea quelea,* and this may be widespread among tropical and nomadic species. Refractory periods, in those species possessing them, are doubtless an adaptation preventing the species from responding to environmental conditions at a time of year when attempted reproduction would not be successful enough to carry selective advantage (Miller, 1959b).

As far as the Tricolored Blackbird is concerned, fall breeding does not exclude the operation of photoperiodic stimulation (Farner, 1959). However, even if the birds did prepare gonadally on the long photoperiods of summer immediately following the molt, it seems unlikely that this alone could have produced the timing of actual breeding observed this autumn, and a consideration of additional environmental influences seems warranted.

It is becoming increasingly apparent that biological clocks of high accuracy are possessed by many species (Brown, 1957; Pittendrigh, 1958a; Blake, 1959), and the tenacity with which some tropical and southern hemisphere species cling to their normal breeding periods when kept in the north-temperate zone (Baker and Ranson, 1938; Bedford and Marshall, 1945; Davis, 1954) is suggestive of their importance in birds. However, there is no evidence on this point for the Tricolored Blackbird.

The accelerating influence of warmth and the inhibiting influence of cold is well known in most north-temperate species (Marshall, 1959) in spite of Rowan's demonstration that Slate-colored Juncos *(Junco hyemalis)* came into breeding condition in the middle of the winter in Alberta when subjected to photoperiod manipulation. In California temperatures are mild both in spring and fall, although increasing in the spring and decreasing in the fall. Whereas suitable temperatures are probably necessary for both spring and fall breeding in the Tricolored Blackbird, temperature is unlikely to have been influential either in preparing the birds for autumnal breeding or triggering them to breed.

Many experiments and field observations suggest that rainfall is important in stimulating birds to breed, but normally it is difficult, if not impossible, to distinguish rainfall *per se* from the effects it produces

upon the vegetation. In an experiment designed to test this, Marshall and Disney (1957) showed in *Quelea quelea* that immatures breeding for the first time responded to the green grass whereas the adults responded directly to the rainfall. Change of response to rainfall with age may be widespread among tropical and desert species, and its investigation would be an important line of study. Captive Galapagos finches in California were stimulated to sing when rain fell on the cages (Orr, 1945), but recent observations on the Galapagos Islands have shown that many of the species breed prior to the rains (R. I. Bowman, pers. comm.) in apparent anticipation of them (see also Moreau, 1950), so that caution in the interpretation of results with caged birds is necessary. Also, gonadal cycles are poorly known in species that respond suddenly to rain, and, hence, the state of the gonads at the time of rainfall is unknown. Allen Keast informs me that he has gathered evidence showing that many Australian desert birds have enlarged gonads long before the rain actually falls so that ovulation can be completed within two weeks of the first fall of rain.

The rainfall cycle is an important seasonal variable in lowland California. The summer drought is extreme and constant in the Sacramento Valley, there being no measurable mean precipitation for either July or August. The spring breeding season comes at the end of the rainy period, and there is no evidence that rains in any way influence initiation of spring nesting. It is difficult to think of any selective advantage that might be achieved by responding to rains at this time. In the autumn, however, rain might be more influential. In the absence of irrigation, rainfall would be necessary to produce grass growth, and even in 1959 in the irrigated country, both colonies started (as dated from the time of hatching of the first eggs) 15 days after the heavy rain of 18 September. This is strong circumstantial evidence that the heavy rain was important in causing fall breeding, but experimental work is needed on this point.

Since the breeding seasons of most birds are timed so that the young are being fed when the food supply is most readily available, direct influence of food might be expected to be important in stimulating breeding. No experimental evidence on this point is available, but there is some indirect evidence (Marshall, 1951, 1952b). Reduced food intake is known to depress gonadal activity in domestic fowl (Breneman, 1955), and out-of-season breeding in Starlings, *Sturnus vulgaris*, has been thought to be due to man-provided food (Marshall, 1952a). Clutch size of predators varies in response to lemming population density, and if lemmings are too scarce, breeding may be altogether inhibited (Pitelka *et al.*, 1955). Other references are given in Lack

(1954). In all these cases the mechanisms for the response are unknown.

When fall breeding began in the Tricolored Blackbird, the adults were subsisting largely on rice, which is found in great abundance in the stubble fields after harvesting. Clearly breeding could not have been attempted if the adults were not able to supply their own needs in a short period of time each day, but this condition is present in many areas of the valley where breeding did not occur, and many other species that do not breed in the autumn have equally abundant food resources available to them at this season of the year. It is possible that the adults may perceive the insects in the irrigated pastures and freshly flooded stubble fields, but this does not appear likely.

Another category of factors known to influence some bird species can be termed general ecological conditions. Again, there is a wealth of scattered observational evidence but a scarcity of experimental results. In the Tricolored Blackbird these conditions may be of prime importance as the timing of spring breeding in northern California varies several weeks in response to agricultural practices (Orians, MS). The unique fall habitat conditions at both colonies have already been noted. Thus, both the green cattail growth in which all nests were placed as well as the pastures and flooded fields in which food was gathered were irrigation products of restricted distribution in the valley. Such ecological conditions, as a stimulating mechanism, or at least as a permissive factor, are probably important for both fall and spring breeding and, perhaps combined with the early rain, were responsible for triggering fall breeding. Unfortunately, however, I do not know whether the birds had prepared gonadally prior to the rain, and future collecting will be necessary to clarify the role of photoperiod in the Tricolored Blackbird breeding cycle.

In any event, timing mechanisms in avian reproductive biology must be considered in the perspective of adaptational and evolutionary explanations (Farner, 1958; Pittendrigh, 1958b). The great variability between bird species in their response to photoperiod manipulation in the laboratory, in their reproductive cycles when transplanted to another hemisphere, in their possession of a refractory period, speed of gonad maturation, length of time of maintenance of active gonads, variation in clutch size in response to ecological conditions, variability of breeding periods in desert regions, all point to great evolutionary flexibility in the mechanisms behind them. Hence, Wolfson's (1959a) claim that breeding periods in transequatorial breeders, the small tropical clutch sizes in most birds, and supposed smaller size differences between inactive and active testes in tropical species (Moreau, Wilk and Rowan,

TABLE 4

BREEDING SEASONS OF AUSTRALIAN PARROTS IN BRITISH ZOOS*

Species	*Range*
I. Species breeding in spring or summer in both hemispheres.	
Polytelis swainsoni	Inland parts of New South Wales, Victoria and South Australia.
Platycercus caledonicus flaveolus	Western New South Wales and adjacent parts of Victoria and South Australia.
Platycercus icterotis	Southwestern Australia.
Platycercus zonarius barnardi	Southwestern Queensland, interior of New South Wales, mallee of South Australia and adjacent portions of Victoria.
Psephotus haemonotus	Southeastern Australia.
Psephotus varius	Interior of South Australia and New South Wales.
Neophema elegans	Southwestern Australia, South Australia and adjacent parts of New South Wales and Victoria.
II. Species retaining their southern hemisphere rhythm.	
Trichoglossus haematod	Northern Australia.
Platycercus venustus	Northwestern Australia and Northern Territory.
Melopsittacus undulatus	Nomadic over most of Australia.
Psephotus chrysopterygius	Northern Territory.

* Breeding data from Baker and Ranson (1938). Ranges after Peters (1937).

1947) are indications of the influence of photoperiod is not likely to be true. All three of these suggestions demand that the species are unable to escape from the depressing influence of an inadequate photoperiod and, hence, are ecologically hindered. Even Wolfson's temperate Slate-colored Juncos prepare well on constant photoperiods of 12 hours' duration, and it seems unreasonable to postulate that tropical species are not reproducing at their ecological optimum. This does not mean, however, that photoperiod is totally without influence, because, as Wolfson has pointed out, it cannot be eliminated merely because of its constancy.

With respect to species retaining their normal calendar month for breeding after hemisphere transplantation, Wolfson offers the alternative hypothesis that "the day length requirement of these species is such that the time of the breeding season in relation to the calendar year is not altered." I find it difficult to devise a scheme by which the drastically altered photoperiod could produce the timing reported in these cases. The facts suggest to me that day length requirements in these species are such that almost anything can be done within wide

limits without altering the normal internal sexual rhythm. Further analysis of the data on Australian parrots in Baker and Ranson's paper reveals an interesting fact. All those species that change over to the northern spring are from southern Australia, while all those retaining their ancestral breeding season are from northern, *i.e.*, tropical, Australia (Table 4). The one exception is a nomadic species *(Melopsittacus)*, which is known to breed independently of season in the Australian deserts. Thus, as might have been expected, photoperiod seems to be less important to the tropical than to the temperate parrots.

THE ANTIQUITY OF FALL BREEDING

In the spring, when all blackbird species other than the Tricolor are widely dispersed, a dense aggregation of blackbirds always means a Tricolor colony in action. In the fall, however, not only are all the species of blackbirds highly aggregated, but their numbers are also swollen by the influx of millions of birds from elsewhere in western North America. All marshes harbor large roosting flocks of birds which spend much of the day resting, preening, and singing in the cattails. Nesting material is readily available within a few feet of the nest site and need not be conspicuously carried for great distances as often happens in the spring. The adult insects brought to the nestlings are smaller than the larvae brought in the spring so that adult blackbirds flying to the colonies with food are easily overlooked unless closely examined with binoculars. The Haskell Ranch marsh was visited weekly by university-trained biologists in the fall of 1959, and none of them noticed the colony until it was pointed out to them. Thus, breeding could have been going on, at least sporadically, in the fall for some time without having been observed.

In many respects the climate of the Sacramento Valley in the autumn is suitable for breeding. Low mean wind velocities combined with warm weather help to make this period favorable (Table 2). Clearly, the critical factor is the frequency of occurrence of sufficient rains to initiate and maintain adequate vegetative growth to produce the insects necessary to support breeding. I have therefore examined the weather records for Sacramento for the last 60 years to determine the pattern of autumnal rains. If we assume that rain is necessary to trigger autumnal breeding and that the 15 days elapsing between the rain and the start of breeding in the fall of 1959 is representative of the time necessary to come into final breeding condition, a total of 50 days would be required from the first rain until the first young fledge. If we further assume that fledging after 1 December is not likely to be suc-

cessful enough to give selective advantage to late fall breeders, it follows that the first rain must fall before 11 October. If only one-half inch of rain need fall to initiate breeding and another one-half inch in the following month to sustain plant growth, it would have been possible for Tricolors to have bred 18 times in the past 60 years. However, if one inch is needed to initiate, and another inch to maintain breeding, there could have been only seven successful nestings during that period. Heavy September rains with follow-up precipitation have occurred only twice.

Other considerations suggest that the above requirements are too liberal. In other regions out-of-season breeding only occurs after much heavier rains than ever fall in California in the early autumn (Serventy and Marshall, 1957), and although lesser amounts may stimulate gonadal activity, it is not enough to sustain breeding (Keast and Marshall, 1954). Interpretation, however, is hindered by our scanty knowledge of the original vegetation of the Sacramento Valley and its probable response to autumn rains. Before the arrival of European man, valley vegetation probably consisted of a mixture of perennial bunchgrass-oak parkland, ephemeral pools, alkaline flats, extensive marshes, and dense riparian jungles. Virtually none of these vegetation types remain today. Largely gone also is the extensive late winter flooding formerly characteristic of the valley. Early explorers repeatedly reported the Sacramento–San Joaquin Valley as being a huge lake 40 miles wide and 300 miles long.

The response of the current annual vegetation to autumnal rains is usually slow, rapid growth not occurring normally until early spring. The response of perennial grasses was probably slower both because of the growth characteristics of perennials and the retarding influence of mulch. The reflooding of the marshes and alkaline flats probably did not occur until late in the fall or perhaps not until winter in dry years. Thus, the presence of emergent vegetation and production of insect populations are likely to have been rare if not absent.

Agriculture has changed the Sacramento Valley in many ways. The draining of the marshes and establishment of flood-control measures have been among the most important for blackbirds. Such changes resulted in a deterioration of blackbird habitat, but this was in part compensated for by the development of irrigation, particularly rice culture and irrigated pastures, which succeeded the wheat raising of the 1800's. Extensive irrigation began in California at the turn of the century, grew rapidly during the 1920's, 1930's, and 1940's, until in 1956 about seven million acres were under irrigation, over one million of these being in the Sacramento Valley and over three million in the

TABLE 5

CALIFORNIA RICE ACREAGES

Year	*Acres*
1912	1,600
1915	30,000
1920	162,000
1925	103,000
1930	110,000
1935	100,000
1940	118,000
1945	230,000
1948	236,000

San Joaquin Valley (Farrell, 1958). Rice became an important crop about 1920, and today approximately 250,000 acres are planted to this grass (U.S. Dept. Agric. Prod. and Market. Admin., 1949), current acreage being limited by governmental restrictions (Table 5). Following the development of irrigation was the establishment of duck-hunting clubs. Clubs are of many types, from a small pothole used by a farmer and a few of his friends to large, managed marshes with permanent caretakers and elaborate buildings. The effect, so far as blackbirds are concerned, is to provide green cattail growth at a time of year when it is otherwise unavailable, and to provide extensive feeding areas in the stubble fields flooded for hunting. Today about 31,500 acres of land are in duck clubs in the Sacramento Valley (P. L. Arend, unpubl.).

Evidence that favors the view that fall breeding has been taking place, at least sporadically, for a long time is provided by the suitable temperature and wind conditions in the valley in the autumn. Heavy rains do occur occasionally in the early autumn, and there is suggestive evidence that the fall breeding of 1959 was triggered by rain. Also, the possibility of more suitable conditions in the original vegetation cannot be ruled out.

Set against this, however, is evidence suggesting that breeding in the autumn may have a recent origin. The response of the original vegetation to fall rains was probably insufficiently rapid to provide the insect population needed to support breeding. The breeding of 1959, although apparently stimulated by natural rainfall, was completely dependent upon nesting sites and feeding areas provided by irrigation, and, since no additional rain fell during the breeding period, nesting would have been a complete failure under natural conditions. The poor synchrony and lack of good colony structure, which characterized both fall colonies, suggest that fall breeding is of such recent origin that time has

not been available for the species to have evolved a good response to autumnal conditions. Furthermore, if breeding had been going on for a long time, one might have expected the species to have evolved a smaller autumnal clutch size because feeding conditions would always be poorer than in spring due to short day lengths and lower insect populations. Yet clutch size was the same in fall and spring colonies. Suggestive evidence is also provided by the failure of any other Californian birds to show regular fall breeding. If environmental conditions had been suitable in the past, it is likely that a number of species would have been able to capitalize upon them. In western Australia, where fall breeding occurs following heavy, unseasonal, late summer rains, many species respond in large numbers (Serventy and Marshall, 1957). In 1953, following heavy late March rains, 22 species were found breeding or showing signs of it, and 16 others were shown histologically to have been stimulated. Heavy rains in February 1955 were followed by breeding in at least 40 species, and an additional seven species were influenced. In all cases there had been normal breeding the previous spring.

I therefore conclude that fall breeding in the Tricolored Blackbird, although it may well have taken place prior to 1959, is most probably a man-induced phenomenon, which postdates widespread irrigation in the valleys of California. Furthermore, its future would seem to depend upon the continuance of agricultural and hunting practices that provide nesting and feeding sites at this time of the year. At first it might seem unlikely that an additional breeding season could be created by agricultural modification of the country, but Belcher (1930) noticed grass warblers breeding out of season in Nyasaland when banana plantations were flooded, resulting in a rank growth of vegetation. As irrigation continues to modify the vegetation in many parts of the earth, it may well be that many species will respond in a similar manner.

Natural Selection and Autumnal Breeding

Whether or not a double breeding season in the Tricolored Blackbird will confer selective advantage to those individuals responding to autumn conditions will depend upon a delicate balance between the advantages of the increased productivity and the increased mortality. Mortality among adults undertaking autumnal breeding may be expected to be greater than among nonbreeders, because there may be increased susceptibility to predation or increased winter mortality resulting from the birds having entered the winter in poorer physical condition as a result of the metabolic strain of breeding. If the survival of fall-

produced young is great enough to offset this increased mortality, advantage will accrue to fall breeders, and the proportion of the population responding to suitable fall conditions will increase.

The increase in productivity made possible by autumnal breeding varies greatly depending upon the breeding pattern of the individuals within the population. The intrinsic rate of natural increase for the species would be most greatly increased if fall breeding made possible reproduction by six-month-old individuals, since the age at which first offspring are produced has the greatest influence upon this population parameter (Cole, 1954). As we have seen, however, breeding by immature birds does not seem to have been the case, although it cannot definitely be excluded. The increase in productivity made possible by breeding twice each year once the age of one year has been reached is less pronounced than in the above situation, but it is nonetheless significant. It is nearly equivalent to doubling the number of fledglings reared if survival is the same in spring and fall, and if fall-hatched young are able to breed the following spring. However, we have seen that nestling survival in the fall was very poor, and we do not know whether fall-hatched females will be able to breed the following spring. Males most surely will not, but they may breed when they are one and one-half years old, which is earlier than spring-hatched individuals do. If, in addition, fall breeders were unable to breed the following spring, the reproductive rate would be further lowered, in fact lowered below what it would be if only spring breeding were attempted. If, however, we assume that adults are capable of breeding twice annually, the most likely situation based upon present evidence, even low success among autumnal breeders is likely to carry selective advantage, because mortality among adults due to predators in the Sacramento Valley seems to be very low. Accipitrine hawks are very scarce, and the easy feeding conditions for adult blackbirds in the fall make it likely that they could rapidly make good the physical strain incurred through breeding, so that their winter mortality should be little affected if at all. However, the spread of genotypes with low thresholds of response to fall conditions will not necessarily cause widespread fall breeding because agricultural practices insure that threshold stimuli will occur only in restricted areas. If the use of irrigated pastures and the practice of flooding the rice fields in the autumn continue, fall breeding should persist as a minor but interesting part of the breeding cycle of the Tricolored Blackbird.

SUMMARY

Thousands of Tricolored Blackbirds bred in at least two colonies in the Sacramento Valley of California in October and November 1959. Nesting success was low, but some young were fledged from both colonies. Breeding was entirely dependent upon agricultural and duck-hunting practices, and it is likely that fall breeding is of recent origin, postdating irrigation in that area. Rainfall seems to be the most likely factor inducing fall nesting, but the population may have been physiologically prepared some time before the rains came. Because of favorable conditions for adult blackbirds, fall breeding is likely to confer selective advantage upon those individuals responding to autumnal conditions in spite of low breeding success such as was observed in 1959.

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A HISTORY OF THE PASSENGER PIGEON IN MISSOURI*

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THE Passenger Pigeon *(Ectopistes migratorius)* has been extinct for nearly half a century. But, long before its final disappearance, Missouri's skies were sometimes dramatically filled with flocks of pigeons, and oak-hickory forests of the state once fed a share of these wandering avian armies.

This account is a report of the misfortunes of the Passenger Pigeon in Missouri, as revealed in histories, diaries, travelers' journals, and popular lore. To so complete a general history as that of Schorger (1955), I can add only the richness of local material and a clarification of certain details. Abundant new material undoubtedly awaits the searcher into early newspapers and market records.

Records have been arranged chronologically by decades and, when possible, by years within the decade.

Early days. Many quotations from early French explorers in the Mississippi valley may be found in Wright's papers (1910, 1911). As a rule, it is difficult to place such quotations with much geographical precision, but two identifiable references may be mentioned. Granvier (Thwaites, 1896–1901 (65): 109–111) wrote from below the mouth of the Ohio River, October 1700: "We saw so great a number of wood-pigeons that the sky was quite hidden by them." In 1750, Vivier (*ibid.*, 69: 145) credited the country in the latitude of St. Louis with wild pigeons in "the autumn through the winter, and during a portion of the spring."

1800. While at Dubois River, Illinois, waiting to begin their ascent of the Missouri River, Lewis and Clark (1893: 1282) noted on 12 February 1804: "Pigeons, geese, and ducks . . . have returned."

In travels northward on the Mississippi, before he began his great southwestern journey, Pike found a nesting colony of pigeons. In his journal for 28 April 1806, he wrote (1895 (1): 212):

> Stopped at some islands about ten miles above Salt river, where there were pigeon-roosts, and in about 15 minutes my men had knocked on the head and brought on board 298. . . . the most fervid imagination cannot conceive their numbers. Their noise in the woods was like the continued roaring of the wind, and the ground may be said to have been absolutely covered with their excrement. The young ones which we killed were nearly as large as the old, they could fly about ten steps, and were one mass of fat; their craws were filled with acorns

* Contribution from Missouri Cooperative Wildlife Research Unit, Columbia, Missouri.

and the wild pea. They were still reposing on their nests, which were merely small bunches of sticks joined, with which all the small trees were covered.

Met four canoes of the Sacs [Indians], with wicker baskets filled with young pigeons. . . .

Bailey (1939) placed this nesting in Pike County, Missouri; Schorger (1955: 124) referred it to Pike County, Illinois. Unless one is fairly certain as to the size of the island involved and the precision of Pike's estimate of distance above Salt River, it is probably not possible to decide to which state the nesting ought to be accredited. At any rate it is a matter of political, not pigeon, geography.

Although Lewis and Clark from May to July followed the Missouri River to the northwestern corner of the state, and Pike's party ascended the Osage to the western border of Missouri in July and early August, neither group made further remarks about Passenger Pigeons. There were acute and interested observers in both groups, and such circumstances tend to substantiate the suggestions of Schorger (1955: 257; *in litt.*, 1956) that Missouri was outside the main nesting range of the pigeon.

Christian Schultz (1810 (2): 17–18) stopped at the mouth of the Ohio on the Missouri side, 24 October 1807. Large groves of willows along the mud flats of the river "at a distance had the appearance of having suffered from a hurricane or tornado, but . . . I discovered that this scene of destruction had been committed by a tribe of the feathered creation! Here was a space of about forty acres of willows which had not only all the branches broken off, but likewise many of the middling sized saplings were bent to the ground, while the surface was literally coated over with dung and feathers. I soon discovered that this was a pigeon roost, and that, from the myriads which come every evening to the same place, the branches are crowded at every twig, until, by the increase of weight, they are broken off." Schultz (*ibid.*, 85) again saw pigeons just north of the Ohio's mouth on 6 March 1808, the "woods being literally covered with them."

1810. When Audubon was camped across the Mississippi River from Cape Girardeau in December 1810 (Audubon, 1942; 1831–39 (4): 538), pigeons, among other game, were killed. He apparently saw no great flights.

At the Nodaway River, on the Missouri, 18 April 1811, John Bradbury (1819: 68–69) wrote:

I proceeded to examine the neighboring country, and soon discovered that pigeons . . . were in the woods. I returned, and exchanged my rifle for a fowling-piece, and in a few hours shot two hundred and seventy-five, when I desisted. I had an opportunity this day of observing the manner in which they feed: . . . an example

of the rigid discipline maintained by gregarious animals. . . . One of these flocks, when on the ground, will cover an area of several acres . . . the birds so close to each other that the ground can scarcely be seen. . . . that all may have an equal chance, the instant that any rank becomes the last, it rises, and flying over the whole flock, alights exactly ahead of the foremost. . . . there is a continued stream of them in the air.

About the same place, on 7 May 1811, Brackenridge (1816: 75) also killed some pigeons. If either of these men saw other pigeons during the rest of the Missouri part of their journeys up the Missouri River, they made no mention of it.

Schoolcraft (1821: 22) saw pigeons while in the Bryant Creek area of Douglas and Ozark counties, 21 November 1818, but he assuredly did not see them in spectacular numbers during his long midwinter journey in Missouri and northern Arkansas.

1820. From Warren County, Duden (1829: 150) wrote in 1826: "Wild pigeons appear at times in swarms which darken the sky like storm clouds. The branches of trees break when they sit down." That Duden's statement was no exaggeration may be gathered from a contemporary newspaper item. Despite the injury done by the drought, the St. Louis "Missouri Republican" (Anon., 1825) assured its readers on 10 October 1825, "there can be no apprehension of starvation, if we may judge from the number of wild pigeons daily passing, and the quails, that are running about our streets and flying into houses in order to escape the pursuit of boys."

1830. Prince Maximilian killed some pigeons when on the Missouri, near the mouth of the Kansas River, 21 April 1833 (Wied, 1839–41 (1): 272). In assessing his observations on American birds, Maximilian later wrote (Wied, 1858: 425): "On the Missouri the specimens which we killed in the autumn and which stayed in the high poplar woods had filled up their crops with the fruits of these trees." If the latter reference was meant to apply to the state of Missouri (Schorger, 1955: 41), Maximilian supplied the wrong date, for he was not in Missouri in autumn (Wied, 1839–41); Schorger has suggested (*in litt.*, 1957) that he meant poplar catkins (not seeds), in the spring of the year.

Townsend (1839: 126) observed "large flocks of wild pigeons passing over" 31 March 1834, in St. Charles County. Hesse (1946–48 (41): 171) wrote from the lower Osage River about 1835 that the "passenger pigeon arrives in spring and fall. Some flocks at times stay for weeks in the forests."

1840. Audubon shot two wild pigeons near St. Joseph in early May 1843 (Audubon and Coues, 1898 (2): 473, 475). He saw no large

flocks of pigeons while on his round-trip tour of the Missouri River in that year.

Mark Twain (1924) remembered roosts of "millions" of pigeons near Hannibal in the 1840's; guns were not necessary, and clubs were used to kill the birds at night. An early settler of Callaway County told (Anon., 1884b: 140) of "a few pigeons" being among animals killed in the 1840's in a spring hunting contest to relieve young corn from pest damages.

1850. On 30 September 1851, a St. Louis newspaper reported (Anon., 1851a):

> Wild pigeons, in immense flocks, continue to pass over our city. As an article of food, these birds are no longer a luxury,—they overstock the market, and for cheapness recommend themselves over every other species of flesh or fowl. Our population, too, have become a sporting population, as is evinced in the continuous and deafening discharge of fire-arms in the vicidity [*sic*] of the city each morning, for several hours. On some days, no one who has not seen them, can form an idea of the large numbers of pigeons that fill our woods. . . . We hear every day of instances when a single shot has brought down from ten to fifteen birds, and . . . as many as twenty-six. . . . a friend of ours, a few days since, in the course of three or four hours, bagged some ninety-six birds.

Pigeons apparently left and then returned, for on 24 December 1851, the same newspaper recorded (Anon., 1851b):

> Immense flocks of wild pigeons have been, for the last few days, in the woods west of the city. A resident in the country says he saw a flock day before yesterday, at least half a mile long, and many thousands in number. They have been so numerous as to break the small limbs of trees when they alighted. It is a singular thing to see them in flocks at this season.

I believe that there is in this report an understanding that pigeons were properly fall and spring migrants. When Kurz visited the St. Louis region, he wrote (1937: 340) 25 May 1852, that the "season for passenger pigeons . . . was already over."

Pigeons visited Harrison County in immense flocks, according to A. F. Woodruff, who arrived there in 1858 (Wanamaker, 1921: 305). Limbs would be broken from trees, and hunters killed the birds by the thousands.

Moniteau County was also the site of large roosts in the fifties (Ford, 1936: 76), and to those roosts, pigeons had been coming for many years.

> When it [the pigeon] did come, it came in countless thousands. A roosting place was selected, and all returned to it at night. In the daytime they separated into droves and foraged from thirty to fifty miles from the roosting place. . . . About six miles northwest of California is what is known as the pigeon roost country. . . . The signs still remain in the broken timber and the wonderful richness of the soil. . . .

In 1852 the pigeons had a roost on the Gravois, about twenty miles south of California. . . .

The greatest of the flights was in 1859 [not seen by the narrator, as he was absent]. . . . At that time the roosts were about ten miles south of California near the Burris fork. . . . The dead birds were brought to the town by the wagon load, and as the railroad had then reached the town, they were shipped to St. Louis by the carload.

1860. An intelligent account of the last days of the Passenger Pigeon in the Newton County region has been written by Britton (1929: 51–60), based on his own memories. He saw immense flocks up to the time of the Civil War. They came to eat mast, competing with the hogs, and stayed in the fall until freezing weather came, the flocks increasing in size until they covered the visible horizon for an hour or so at a time in the afternoons. They passed through the country again in March. They gave no trouble in corn fields, and nesting, if Britton makes no mistake in his report, was not at all colonial. Late in spring, as the mating and nesting season came on, they "were seen in pairs by those having occasion to be hunting or passing, in the most inaccessible woods or forests." He considered those nesting in his region as mere stragglers from areas more densely populated by pigeons. Excreta accumulated to a depth of two or three feet after an area was used for several years by roosting pigeons. In the 20 years following 1883, Britton traveled in all the timbered country of southern Missouri, northern Arkansas, and western Tennessee without seeing a single pigeon.

Feed lots around cow barns were full of pigeons during the winter in Cooper County as late as 1862 (George, 1911). In the late fifties and early sixties, great flocks came to a large roost on Moniteau Creek —a tract that was still (1911) known as "The Pigeon Roost."

They would start out early in the morning for their feeding grounds and in the afternoon, about four o'clock, they would begin returning to this roost. From that time until it was too dark to see, I have watched that unbroken line stretched against the sky as far as the eye could reach. . . . I remember thinking it looked like some mighty river winding its way through the air.

An immigrant Englishman who lived in Van Buren County, Iowa, kept meticulous records of birds and mammals killed and seen from 1856 to 1863 (Savage, 1933–37). He mentioned pigeons on the following dates: 2/21/60 ("flock"), 4/1/60, 9/16/60, 4/5/61, 7/31/61, 8/12/61, 3/15/63 ("pigeons plentiful"), 3/20/63, 4/5/63, 4/6/63, 7/4/63, 7/18/63, 9/6/63, 9/26/63, 9/30/63, and 10/4/63. For this Iowa county that borders Missouri's northeastern counties of Clark and Scotland, it will be seen that of 16 records, there are no real winter

dates; the records fall as follows: one for February, two for March, four for April, three for July, one for August, four for September, and one for October. I am not certain that Savage's pigeon records were as complete for the early years as for 1863—if they were, he saw none in 1856–59 and 1862. Unfortunately, publication of Savage's diary was cut short with the 1863 entries.

According to the county historian, the last flight of pigeons in Moniteau County in 1868 was greeted in the usual manner (Ford, 1936: 76). "They settled in the trees and shrubbery about the Catholic church. Some of the boys went out and got a few sackfuls. They left in the morning and never returned."

1870. In 1872, large flocks of pigeons were observed in Franklin County by Eimbeck (Widmann, 1907: 84), and from many reports it becomes obvious that the decade of the 1870's was a time of sporadic abundance of Passenger Pigeons.

John A. Bryant told Harris (1919: 258) that pigeons were present in the Kansas City region in 1873 and 1874: "'Killed fifteen at one shot in September, 1873.'" I find no more reports for 1873, but in the spring of 1874, Scott (1879: 147) noted the birds at Warrensburg, Johnson County: "A flock of seven seen on April 6." Then, in the autumn of 1874, a spectacular colonial roost began in southwestern Missouri.

A Springfield paper reported on 29 October (Anon., 1874a): "Twenty-five hundred pigeons were killed one night near Mt. Vernon," and on 5 November the same paper carried the report (Anon., 1874b): "Wild pigeons are so plentiful in Lawrence county that they sold for ten cents per dozen."

Charles Boutcher, a Pennsylvania sportsman, arrived in Springfield in December. He described (Boutcher, 1875: 7) a large pigeon roost that had been located near there:

> . . . we regretted that an unusual and severe snow storm for this latitude broke up and dispersed this roost just about a week before our arrival. . . . We saw a portion of the camping grounds of these birds, and had descriptions of them. . . . It covered a space of about thirty square miles of closely wooded large timber and scrub oak (ten miles by three miles). . . . it would be impossible to compute their numbers. . . . Tons upon tons of them were nightly killed, and the shipments and local supplies were so great that they were a glut and a drug . . . and could be . . . bought in quite distant markets for 5 cents a dozen or less. . . . They were packed so densely that the strong oak limbs and saplings were snapped and crushed like pipe stems. The part of the "roosting ground" that we saw looked as if it might have been the scene of a battle with grape and canister. . . . [At the roost] throughout the day scarcely a bird was to be seen. Again at night and until midnight they would pour into their "roosts."

A great pigeon roost in 1874, apparently the one described by Boutcher and referred to by the Springfield newspaper, has been mentioned in the history of the Ozark region (Haswell, 1917: 116, 234). It was said to have included "the whole southwestern country." One of the big roosts was in the valley of Wilson Creek, west of Springfield; another was in a thickly settled community near Mt. Vernon.

There are no reports of pigeons in 1875, and none that I have found for early 1876. However, at Jefferson City, 29 September 1876 (H.C.M., 1876), a man wrote that "only a few wild pigeons have made their appearance." It is unfortunate that more dispatches of this nature were not published, for we might then know more about the genesis of a great pigeon roost in central Missouri in the autumn of that year.

"Rod and Gun" (Anon., 1876) on 18 November 1876, carried a dispatch said to have originated in the "Southland (Mo.) Rustic" (Stoutland, Camden County, was certainly the place meant, but no one has been able to identify the publication). A pigeon roost was described.

> Pigeons have come into this part of the country by the millions. Of evenings the sky is darkened with them. They have made Dobson's [Dodson's?—see 1877] farm their headquarters, and at nights the trees and underbrush are loaded with multitudes. A little before sundown large armies of pigeons are seen coming from different points of the compass, but each army passes onward. . . . After a while they return and settle on the trees around the roost, not many of them nearer than a mile of the place. They make sudden flights from these trees, and the sound of their wings is like that of a great storm. . . . After dark they fly toward the roost and for a long time they fly to and fro, and have the appearance of bees swarming. . . . The pigeons keep up a constant chattering, which can be heard for miles away. . . . sleep . . . is out of the question with pigeons. They are disturbed by themselves . . . and the incessant discharging of firearms among them causes them to change their location almost constantly. This roost is visited every night by crowds of men, some with guns others with poles. . . . But no one can ever imagine what a pigeon roost is, or how much noise they make, until one is seen and heard. There is an abundance of mast here now. . . . One curious circumstance is that in the neighborhood of this pigeon roost we never see a pigeon from the time they leave of mornings until they return of evenings. . . . but somewhere they are all feasting abundantly, for they are all fat.

It was said (Anon., 1877) that over 100,000 pounds of pigeons were shipped from Stoutland in 1876.

Passenger Pigeons roosted in large numbers at Stoutland again in the autumn of 1877 (Anon., 1877):

> A pigeon-roost is a big thing, and they have a big pigeon-roost on the Auglaize river, near Dodson's camp-ground, Camden county, Missouri. It is an annual roost, and disturbs the quiet of the people of the section. . . . There is a frightful confusion of noises. . . . The crashing of limbs—the roaring of multitudinous

pigeons, and the cracking of shot-guns sweeping the birds down [make it difficult to sleep]. . . . Besides this, there is a darkening of the air by the birds in their flight, which makes continual cloudy weather. . . . The pigeon has become a leading article of commerce . . . and the pigeon yield this year promises to be as good [as last year]. . . . everything else stops in the pigeon-roosting season except the newspaper.

The pigeon roost was a remunerative kind of nuisance!

In a report obviously unrelated to the Stoutland roost, a Chicago game dealer claimed (Bond, 1877) that there were two major nesting groups of pigeons in 1877: one in Ripley County, Missouri, and one in Benton County, Arkansas. If any reliance at all is to be placed on his statement, current beliefs concerning nesting of the Passenger Pigeon in Missouri will have to be somewhat revised. I have not discovered any corroborating evidence for 1877, except for another bald statement (Mann, 1880–81) that pigeons nested in Ripley County in 1877, which Schorger (*in litt.*, 1956) has labeled "doubtful." My guess is that some people, through ignorance or intent, did not always distinguish between roosts and nestings of pigeons.

In one of the periodic efforts by sporting magazines to chart the flights of pigeons, the editor of "Forest and Stream" wrote on 14 February 1878 (Anon., 1878b): "Correspondents will oblige us by keeping us informed of the whereabouts of wild pigeons. The birds were in southwestern Missouri at latest advices." From Audrain County came the information (Anon., 1878c): "Mexico, March 2. Pigeons here for two weeks past; are now flying northeast." I have no more information on the spring season in 1878, except for reports (Anon., 1878a) of an extensive roosting in Van Buren County, Iowa, near northeastern Missouri. There, a letter published for the week of 30 March indicated that "countless millions of pigeons have been covering about three thousand acres of jack-oak timber" for at least a two-week period. Thousands had been killed before the roost began to move.

In 1879, another large movement of pigeons was in progress, this time in the southern part of the state. The St. Louis "Republican" (Anon., 1879b) for 21 March reported:

The woods in Shannon, Oregon and Howell counties are full of pigeons, which are being killed by the thousands for shipment to eastern markets. Piedmont [in Wayne County, Missouri], on the Arkansas division of the Iron Mountain railroad, is the shipping point, and from there are shipped every day from seven hundred to one thousand dozen of pigeons, bringing into the county from six to eight hundred dollars, net cash per diem. The birds are sent to Boston and New York, where they sell at $1.30 and $1.60 per dozen. The roosts of the pigeons are from sixty to eighty miles from Piedmont. . . . The pigeons are continually moving toward the north, but their progress does not exceed eight, or, at the

utmost, twelve miles per day. . . . The hunters watch their game settle down, and then range through the woods . . . and when a body of pigeons settled on the limbs of a pine or oak is outlined . . . a half dozen men fire at a signal. . . . In the morning all hands are set to work to pick up the game.

Doubtless referring to the 1879 pigeon roost near Piedmont, E. T. Martin, a Chicago live pigeon dealer, told to Chicago "Field" (Anon., 1879a) about 22 March that he had located "a large nesting of pigeons." The congregation of pigeons was about 120 miles from St. Louis, and "over fifty miles from any railroad, and it seems impossible to get them to any market [in a living state, he meant]. The nearest railroad station is said to be Piedmont, Mo. In as much as feed is very abundant there and is scarce in Wisconsin and Michigan, it seems likely that the birds will remain there for several hatchings, and hence there will be few, if any, for the many tournaments advertised for May." Since Schorger (1955: 125) admonishes that "Martin is not to be believed on details," one may suppose that Martin was engaging in a little propaganda to keep high the price of live pigeons that were used in the then-popular pigeon-shooting tournaments. In this case, however, pessimism was justified. On 10 May, for instance, the editor of "Field" (Anon., 1879d) warned:

We are afraid the tournaments are going to have much trouble to get birds. . . . An inquiry . . . reveals the fact that wild birds are not to be had. The only nesting place known of is in Missouri, and that is so far from a railroad as to render it impossible almost to get the birds . . . at a price at which associations can afford to buy them for their tournaments.

However, on the same page of the "Field" there is an editorial note (Anon., 1879c): "The St. Louis tournament.—The Missouri State Sportsmen's Association tournament have secured and have in coops all the birds they will require." No information on the origin of the latter birds is given.

1880. The story of the Passenger Pigeon in the 1880's reflects the erratic qualities of the species itself. Even though some observers saw their last pigeons during that period, the bird still appeared in considerable numbers in a few sections. It was harried to the last by market shooters, who killed for food, and by netters, who took for the sport of trap shooting. The use of live pigeons in trap-shooting tournaments was almost over by about 1880, however, due mostly to the uncertain supply of pigeons (Schorger, 1955: 164–165). In 1885, St. Louis and Indianapolis trap shooters were "engaged in a laudable endeavor to prove the adaptation of the English sparrow to trap-shooting," thereby solving simultaneously the sparrow pest problem and pigeon shortage (Anon., 1885c). (Before glass balls and clay

"pigeons" finally replaced live birds, sparrows, Purple Martins, and bats were suggested—bats were used rather successfully, and for some time, in the sporting weeklies of the day, scores were regularly reported upon for bats, particularly in Louisiana and California.)

In the realm of folklore, at least, the bird still flourished. One rather wild report (G.S.B., 1880) divided the nesting pigeons into three groups. One of those flocks was found in Missouri, drifting "about from season to season following the crop of nuts and rarely going beyond the boundaries of their own States."

On 29 September 1880, J. D. Kastendieck killed his last specimen of the Passenger Pigeon, at Billings, Christian County (Widmann, 1907: 84).

For 1881, one can only accept the word of the editor of Chicago "Field" (Anon., 1881a): "As is well known, this is what is termed the 'off year' for wild pigeons." In January it was said (Anon., 1881b) that "immense flights of wild pigeons have established nestings in the dense timber lands bordering on Southwestern Missouri" (*i.e.,* in Indian Territory). Birds were shot in great numbers, but the point was 75 miles from a railroad, and netted birds could not be supplied with food (Anon., 1881a). W. W. Judy *(ibid.)* in late March advised associations to put off tournaments until later in the year in the hope that the pigeons would move into Missouri for another nesting. These dispatches are only samples of the pigeon market literature: it would be difficult to learn how much of the mass of fabrications, self-deception, and slanted information the marketeers themselves believed. At any rate, with their bland announcements about "nestings," first, second, or even more nestings, they went about their business of hounding the pigeons into extinction (see Schorger, 1955; also see Chicago "Field," 15: 168, 232, 1881, for further information on the Atoka, Indian Territory, "nesting"). At least one Missouri sportsman (Occident, 1881) endorsed the stand of "Forest and Stream" against the shooting of live pigeons at tournaments.

In a long letter written in November 1881, William King (1881) painted a somewhat glowing picture of game in "the mountains" of Washington and Crawford counties. It appears, however, that the information was based on considerable experience in the region. After including Passenger Pigeons among the large quantities of game animals found there, he wrote:

> Wild pigeons are mostly birds of passage, although they have their pigeon-roosts sometimes in the mountains, where thousands can be slaughtered, and many are killed by clubs alone. The wild pigeons annually appear in the fall about the beginning of October and continue through the winter and spring; they fly in

large flocks over and through all parts of the mountains, darting through the air with immense velocity. Frequently from twenty to thirty may be brought down by the double shot; they are also caught in nets in large numbers.

Without stating the month, George (1911) wrote of seeing 10 or 12 pigeons near Gunn City, Cass County, about 1882. He had seen since his arrival there in 1865 "a few small flocks and killed two or three pigeons."

Widmann (1907: 84) saw several large flocks going north at St. Louis on 5 and 6 February 1882. At Keokuk, Iowa, near the northeastern corner of Missouri, on 6 February, a man wrote (Scott, 1882): "A large flock of wild pigeons passed over Sugar Creek yesterday; two were killed, a male and a female." From Thomasville, Oregon County, 7 February, word was (Sassafras, 1882): "Wild pigeons are roosting in large numbers within four miles of this place, and every 'shooting iron' in the place is kept hot in their destruction." W. W. Judy, famous pigeon dealer, wrote (Judy, 1882a) from St. Louis, 12 February: "Wild pigeons in considerable numbers are feeding opposite this city in the American Bottom [Illinois]. Quite a quantity have already been shot." According to a dispatch to American "Field" in March (Anon., 1882), "a very large roost" was at Brunswick, Chariton County.

A little later in 1882, Judy (1882b) reported on the spring's success in trapping: "This spring they made their appearance in southwest Missouri early in February, and shortly after large roosts were formed in Lincoln and Chariton counties in north Missouri. . . ." There had been no success with netting, and the pigeons were said to have then gone on to Michigan and Pennsylvania. There is little information on the pigeon for the rest of 1882. Cooke's observer at Vesta, southeastern Nebraska, reported (Cooke, 1882) pigeons "going north in large flocks 4/21–25; two large flocks on 5/5."

On 21 April 1883, "Field" announced from Chicago (Anon., 1883b): "Messrs. Bond & Ellsworth inform us they have received a telegram from W. W. Judy, of St. Louis, stating that he is at Augusta, Mo., and there is a large nesting of wild pigeons near there." Bond and Ellsworth were mistaken in identifying the place as Augusta, St. Charles County, as the town Judy referred to was Thayer, Oregon County, which was given the name "Augusta" for a short time (Pottenger, 1945). They later (Bond and Ellsworth, 1883) amended their report:

The nesting is said to be about forty miles from Augusta, Oregon county, Mo., on the south line of the state. We do not hear of any birds being caught; none coming here, or going to New York. . . . The birds may come to Michigan by the middle of May, as by that time they will have hatched out their young in Missouri.

Judy himself (1883) reported on 12 May:

I returned to-day from the wild pigeon roost, located eight miles south of Augusta, Oregon county, Mo., where there is a small body of birds nesting. There are about forty netters there, but thus far the catch has been very light, as the pot-hunters are shooting them out, and will not allow the main body to nest. I am in hopes the birds will be driven north. . . . Unless there is a change soon . . . clubs will have to look elsewhere for birds.

The distances given by Bond and Ellsworth and Judy are in contradiction; the figures were probably round numbers, and they may have been garbled. If either eight or 40 miles are taken as a literal distance ***due south*** from Augusta (*i.e.,* Thayer), the alleged nesting took place in Arkansas. Both reports, however, specify Missouri, and that birds were present in that general area in the spring of 1883 is confirmed by an account from Ripley County, some 20 to 30 miles northeast of Thayer. The Doniphan "Prospect-News" for 30 March (Anon., 1956) noted:

There have been more than 10,000 dozen wild pigeons shipped to St. Louis from Piedmont with[in] the last two months and more are constantly being shipped. The "roost" where most of these pigeons are killed is in the northwest corner of Ripley, close to the Oregon and Carter County lines.

It is significant that the local dispatch refers to this pigeon flock as "roosting"; but it ought to be noted that the communications of Judy calling it a "nesting" are of somewhat later date.

This ends the discussion of the pigeon for the spring of 1883, unless there is some connection with a report of M.R.B. (1883), who reported from Chicago on 12 June: "It has been reported lately that the pigeon nesting in Missouri has been robbed of all the young. One man is said to have 60,000 young birds in his possession, and several others 10,000 each" (the implication being that the men raised the young birds until they were old enough to be used in trap shooting). In commenting on this event in 1884 (M.R.B., 1884a; 1884b), the same person related that 40,000 (of 60,000) of the birds had died before their holder could dispose of them. He told of another man who lost all but 3,300 out of 20,000 birds secured in Missouri in 1883. Specific nesting dates and localities were not given.

In the autumn of 1883, pigeons were common for the last time at Keokuk, Iowa (Widmann, 1907: 84). The winter that followed must have been very nearly the last time that the wild pigeon was present in really impressive numbers in Missouri. For that occurrence, a Tennessee report quoted by a New York magazine must be relied upon. That undated dispatch, carried in "Forest and Stream" (Anon., 1884a)

in early January 1884 (credited to the Memphis, Tennessee, "Avalanche"), recorded "a pigeon massacre at a Missouri roost."

> Hearing that game was abundant on the line of the Kansas City Railroad . . . we formed a party to go out. . . . Near Augusta, Mo., . . . the roost of pigeons was represented to us to be "perfectly enormous." . . . Early Thursday morning . . . with four days' rations . . . we made the start over the hills. . . . On the way we shot a few quail. . . . [We encamped the first evening and next day] before the light of morning came our tent and all hands were in the wagon, and as the sun rose, the birds began to fly over us, and all day at short intervals we were shooting right and left in the roost. The trees were literally crowded with them. . . . Their roost occupies a space of about five miles long and three miles wide, and when the pigeons come in at night and leave in the morning they actually darken the earth around. At 10 o'clock the second night we had one wagon box full and left for a camping ground. En route we met Joe Bowlinghouse, an experienced hunter, whose luck that day brought him three fine deer. . . . At this juncture another crowd of hunters, with two teams filled with pigeons, came upon us. . . . At daybreak next day we all started for Augusta, and got there a little after dark. When our pigeons were counted (three wagons), we had 5,415, and in our own we had 1800.

The reference here was probably again to Augusta (*i.e.*, Thayer), Oregon County, as the correspondence originated in a Memphis paper, and since "Augusta" was on the Memphis-Springfield segment of the Kansas City railroad, which was completed about 1884 (Thomas, 1917: 8). I also suspect that one would have been more likely to kill three deer in one day in Oregon than in St. Charles County (to which Schorger (1955: 218) referred the pigeon roost).

In 1884, Mrs. Musick (Cooke, 1888: 108) saw pigeons at Mt. Carmel, Audrain County, from 9 to 21 September.

M.C. (1886) on 24 February 1885, "Saw five Passenger Pigeons" at Wayland, Clark County. At Mt. Carmel, in 1885, Mrs. Musick (Cooke, 1888: 108) saw pigeons 18 April and 27 (20 seen), 28 (50 seen), and 30 September. Widmann (1907: 85) saw them, his last record at St. Louis, on 19 September.

A total of 4,929 wild pigeons and 8,129 turtle doves were killed in Missouri for the year ending 1 March 1886 (West, 1886). There is no way to evaluate these figures; they come from a long list of game animals, and were presumably drawn from some source concerned with the St. Louis game market.

At this late date, one of the few public moves to provide legal protection for Passenger Pigeons was proposed by a convention of sportsmen and game market operators at St. Louis in 1885. They suggested (Anon., 1885b) that in states east of the Rocky Mountains pigeons be hunted only from October to March inclusive.

From Alexandria, Clark County, Jasper Blines (1888) wrote in November 1888 that during the year he had seen "but few passenger pigeons. They were in former years very numerous here, and could be seen . . . every spring and autumn." Since food was still abundant, he supposed that their disappearance might be due to locomotive whistles, steamers, and the noise of cities.

1890. In the 1890's, reports of pigeons in Missouri became more scattered. One man writing from Macon County said (Truitt, 1891) there was a roost on Blackwater River, Saline County, in 1890; pigeons were occasionally seen in the Macon County area.

The editor of "Shooting and Fishing" wrote in February 1891 (Anon., 1891), that despite reports of the pigeon's extinction, a hundred dozen or more choice " 'dodos' " from Pennsylvania and Missouri might be seen in the Boston markets. Wild pigeons were not at all near extinction, he maintained, and a change in nesting habits could yet be expected to save the species. The shooting interests did not easily admit defeat!

Emerson Hough (1892) was told in 1892 that wild pigeons visited southeastern Missouri regularly every other year. The roost of the birds at that time was in Indian Territory, where netting was no longer profitable, "but the bird is not extinct." Blines (1892) did not see a single pigeon in Clark County during 1892.

No pigeons were placed on sale in St. Louis markets in 1894 and 1895; and those sold in 1893 had come from Arkansas (Deane, 1895).

Currier saw 10 pigeons 15 April 1894, at Keokuk, Iowa—the first he had seen since 1888 (Widmann, 1907: 85). In September 1896, the last specimens of the Passenger Pigeon from Iowa were taken in Lee County on the northeastern border of Missouri (the last Iowa sight record, however (DuMont, 1933: 80, 81), was in Kossuth County, another county bordering Missouri, in 1903).

Early in 1896, Goss (1896) wrote from Arcadia, Iron County, 14 March that a few days before he "saw in the woods near here a flock of nine." (His statement that he had not seen any for about 10 years does not apply to Missouri, as he was living in Iowa as late as 1895; see "Iowa Ornithologist," 1 (4): 76–79, 1895.)

On 17 December 1896 (Deane, 1898: 185), Charles U. Holden, Jr., shot two pigeons from a flock of about 50, and sent them to Ruthven Deane (Deane, 1897: 317). The pigeons had been killed at Attie, Oregon County. (Attie was once a hamlet one and one-half miles southwest of Rover (Pottenger, 1945), so the place was not Alton, "Altie," or "Attic," as various ornithologists have mistakenly sug-

gested.) Residents of Attie reported to Holden that they had not seen any pigeons for several years previous to that time.

Deane's was the last verified record of the Passenger Pigeon in Missouri, but there is an interesting sidelight to the report. In a column published 26 December 1896, Emerson Hough (1896) related that, while hunting with friends on "a quail trip in Missouri and Arkansas," William Knight had seen "a large flock of real wild pigeons, and he had killed two of them," bringing them home for mounting. Despite differences in names of the shooters and slight variations in circumstances, one wonders if Deane and Hough did not refer to the same hunting incident.

The decade ended, so far as records go, with the report (Widmann, 1907: 85) that a flock of 75 to 100 pigeons was seen in Johnson County, southeastern Nebraska, 17 August 1897.

1900. Otto Widmann reported to Forbush (1913: 100) that Miller, a St. Louis pigeon marketman, received 12 dozen pigeons from Rogers, Benton County, Arkansas, in 1902, and a single bird from "Black River" in 1906. Black River probably refers to southeastern Missouri or northern Arkansas. In 1902, Dr. Eimbeck saw pigeons (number not stated) at New Haven, Franklin County, 26 September (Widmann, 1907: 85). Eimbeck's was apparently the last sight record of the Passenger Pigeon in Missouri; while it is open to question, as sight records always are, Eimbeck apparently stood high in the respect of Widmann.

Summary

Really large flocks of Passenger Pigeons persisted in Missouri longer than did the flocks of parakeets *(Conuropsis carolinensis)*, another eminently social bird that early travelers found common in Missouri. While the parakeet's passing remains a mystery (McKinley, MS), there is less uncertainty as to why the pigeon disappeared. Some of the reasons are plain enough, despite the vested disclaimers of the pigeon trade faced with a declining resource that it had treated, and meant to continue to treat, as inexhaustible. Railroads, of course, speeded up the exploitation in Missouri, and their effects were felt at a crucial time in the bird's struggle for survival. Barrels of dead birds were carried swiftly by train to distant cities from small towns formerly cut off from eastern markets. Armies of pigeon hunters, made dangerously mobile by the new transport, hounded the flocks of pigeons into the most remote parts of the state, wherever they sought refuge. Such a pattern of decimating factors becomes apparent, even from a study of limited

data from Missouri. When these factors are magnified to a nationwide scale and linked with the bird's fundamental need to nest, travel, and feed in large flocks, there is not much mystery left.

Pigeons were often common in Missouri. They may have been somewhat sporadic in their occurrences, but there are many reports of them in fall and spring, and some for winter and summer. Records from the state or bordering counties of neighboring states where dates or seasons are indicated may be summarized roughly as follows:

January	0	September	13
February	10	October	7
March	11	November	3
April	13	December	4
May	6	Spring	7
June	0	Summer	0
July	3	Autumn	7
August	2	Winter	6

The question of relative numbers present in various years and in different seasons can never be very satisfactorily settled. When Missouri newspapers are thoroughly studied and greater use can be made of manuscript material, a clearer picture may emerge. It will probably be found that pigeons did not commonly nest in the state. However, at least one unrecorded nesting, near Dykes, Texas County, perhaps in the 1860's, is among traditions of my family. That record, together with the smattering of references cited here, ought to be further investigated.

Newspaper accounts tell of extreme abundance at times up to the 1870's and 1880's. Then, reports become hazier and more isolated, until the kill records of 1896 in Ripley County and a few sight records up to 1902 end the story of the Passenger Pigeon in Missouri.

APPENDIX

Some indefinite references to the Passenger Pigeon in Missouri have been placed here. General references are arranged chronologically; the rest are listed by county.

County	*Reference, Date, and Other Comments*
General	Stoddard, 1812: 231. No date or specific locality.
	Schoolcraft, 1819: 37. General terms only, 1818–1819.
	Flint, 1832 (1): 291. Numerous in some seasons; no time or locality given.
	Wetmore, 1837: 29. No date or locality given.

Douglass, 1912 (1): 50. Southeast Missouri; present in season in early days.

Hayden, 1862: 172. Pigeons said to be quite abundant on the lower Missouri River, 1855–57; no locations cited, but Hayden collected along northwestern Missouri.

Mershon, 1907: 139. See Van Cleef, below.

Anon., 1874c. Echoes reference Anon., 1874b, without citing county.

Mershon, 1907: 107. Pigeons wintered "in southern Missouri and the Indian Nation" in 1874; they were shot at night and sold in St. Louis.

Van Cleef, 1899. Another attempt to attribute periodic, migratory nestings to pigeons. He says there was a nesting near Poughkeepsie, New York, in the early seventies: pigeons nested first in Missouri, then in Michigan, and finally in the Catskills.

Schaff, 1905: 109. A flock of 75 to 100 birds was seen eating "the little acorns of the water oak" on Black River, Southeast Missouri; probably winter of 1877–1878.

Anon., 1935. No place given (Jefferson City?); a spectacular flight in late winter, 1882.

Anon., 1913. "Main body" of pigeons reported on 9 May 1886, to be in Missouri.

Barry — Anon., 1888: 564. Still present in 1880's (?).

Cass — Glenn, 1917: 87. Author could remember seasonal visits, when flocks, "fully a mile wide and many miles long flew across the country, obscuring the sunlight."

Chariton — Anon., 1883a: 390. Still present in the 1880's (?).

Howard — Widmann, 1907: 84. Pigeons were seen last at Fayette in 1878; information given in 1885.

Anon., 1883a: 390. Still present in 1880's (?).

Jackson — Latrobe, 1835 (1): 105. Late September 1832; Latrobe went on "a morning's pigeon shooting," but left no indication if any were seen or killed.

Laclede — Gleason, 1949: 2. Once present; no date given.

Lafayette — Anon., 1881c: 241. Still present in 1880's (?).

Lawrence — Neff, 1923: 179. Neff's father (born *ca.* 1869) once hunted them; they were abundant.

Anon., 1888: 208. Still roosted there in the 1880's (?).

Newton — Anon., 1888: 208. Still roosted there in the 1880's (?).

St. Charles — Anon., 1885a: 145. Said to be still present in the 1880's.

Texas — Anon., 1889: 429. Still present in the 1880's (?).

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THE SPREAD OF THE CATTLE EGRET IN THE UNITED STATES

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THE entry of the Cattle Egret *(Bubulcus ibis)* into the United States (see Sprunt, 1955, for history) presented an opportunity to explore the ecological problems of population growth and dispersal. No advantage had been taken of previous opportunities (*e.g.*, House Sparrow, Starling, several game birds) to study such problems, but the present case seemed in 1956 to permit an examination of population changes in relation to birth and mortality rates. Therefore, a program to obtain data about the changes in numbers of egrets was initiated, and it was hoped that results of importance to population ecology would be obtained. Unfortunately, the objectives of the program have not been attained. However, since good data on distribution were obtained, this paper describes the spread since 1956 throughout the United States and suggests that little extension is to be expected.

The discovery of the Cattle Egret in Florida and its early history have been ably reviewed (Sprunt, 1955). However, a number of additional notes are listed in the bibliography. Their content is usually self-evident from the title. In addition, notes on the spread of the Cattle Egret in South America, Africa, and Australia are presented.

Data were obtained by writing to bird clubs in the area from Minnesota to Texas and from Florida to Maine. The first letter explained the purpose and emphasized that *spread* can only be demonstrated if absence is proved. Thus a report of absence is as valuable as a report of presence. The following mimeographed forms were sent to about 70 clubs.

1. April 1957—Explanation and request for information up to 1957.
2. September 1957—Request for information for 1957.
3. October 1957—Results and map for 1957.
4. April 1958—Thank you and alert for 1958.
5. October 1958—Request for information for 1958.
6. January 1959—Results and map for 1958.
7. April 1959—Questions about vegetation and alert for 1959.
8. October 1959—Request for information for 1959.

The questionary simply asked for name, area explored, and whether Cattle Egrets had been seen in the preceding spring or summer. The coverage was good except in the Piedmont and in the region from West Virginia to Missouri. In addition, letters were sent to special persons in critical areas and to authors of notes on egrets. Further-

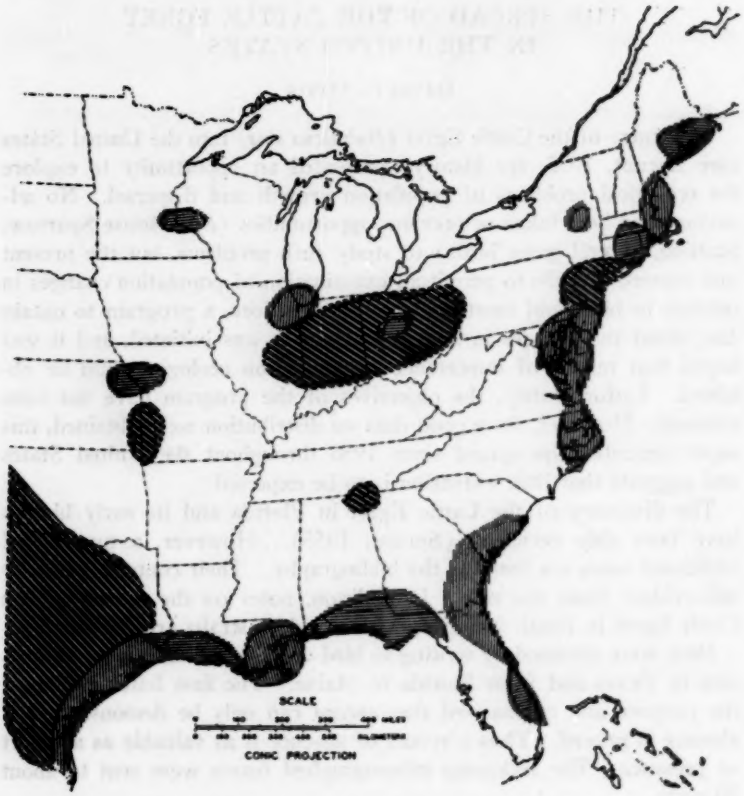

Figure 1. Presence and "absence" of Cattle Egrets in the United States since 1955. Thin, vertical lines show distribution before 1957; thin, horizontal lines, the increase in 1958. Areas of "absence" are indicated by heavy, slanted lines. Areas lacking information are blank.

more, the Audubon Field Notes were examined regularly. By these means, it seems likely that adequate information was available to map the distribution, although certainly some records were missed. At all times, it was emphasized that knowledge of absence is as important as of presence.

It is impossible to list the 80 persons who answered the persistent questions. Perhaps the best appreciation is to make their efforts available to others. The Audubon Society kindly supplied the original list of clubs.

RESULTS

The replies to the questionary may be summarized concisely. By 1956 Cattle Egrets were scattered from the tip of Texas to Boston. Accidentals had appeared in various other places (Chicago) from time to time but had not persisted. The species was absent in the interior and not reported from several areas such as the west coast of Florida and Mississippi. The information for 1957, 1958, and 1959 showed that the species filled in many gaps but still was not reported from the west coast of Florida in spite of special effort to get reports. Accidentals continue to appear in various places (Schenectady, New York; St. Joseph, Missouri; Minneapolis, Minnesota; Columbus, Ohio). Figure 1 shows distribution before 1957 and the increase in 1958. Egrets were considered absent if several groups of persons regularly searched the region. The extent of area for accidentals (Chicago, Columbus, Schenectady, Minneapolis, St. Joseph) is obviously not properly scaled.

The lack of recent extension suggests that the spread of the Cattle Egret has stopped. Although accidentals have appeared away from the coast for several years, none has become established in contrast to the rapid increase along the coast. There are several reasons that might explain the cessation of spread.

One tempting possibility concerns the type of vegetation used for nests. All reports of breeding colonies show that the birds nest low in thick trees or bushes such as cedars, willows, or mangroves. However, Smith (1958) reports birds nesting in tall trees in Cuba. It would be helpful to note whether there are areas in the interior that have thick, low vegetation adjacent to water.

The spread of the Cattle Egret has been trivial between 1955 and 1959. It appears that local extensions will occur and that accidentals will appear in many scattered spots. Several puzzles exist. Why are there so many reports in New England? Why the absence of reports from the west coast of Florida? Why the lack of reports in the New York City area, even though accidentals appeared on Long Island as early as 1954?

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AN ATTEMPT TO ESTABLISH A COLONY OF YELLOW-HEADED BLACKBIRDS*

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THE classic example of the re-establishment of a bird that had been extirpated from part of its native range is Harvie-Brown's (1879) record of the Capercaillie *(Tetrao urogallus)* in Scotland. Other attempts to re-establish species of birds have not been attended by outstanding success. To our knowledge no such effort has been undertaken with any of the passeriform birds.

This paper describes an attempt to establish (or re-establish) a passerine species, the Yellow-headed Blackbird *(Xanthocephalus xanthocephalus)*, in a cattail marsh along University Bay of Lake Mendota at Madison, Wisconsin. The vegetation of this marsh is emergent, or nearly so, depending on water levels. It contains a breeding colony of about 30 pairs of Red-winged Blackbirds *(Agelaius phoeniceus)*. Because of the apparently ideal nesting conditions and because it is within the breeding range of the species, there is reason to believe that Yellow-headed Blackbirds once nested here. Two marshes about five miles away have breeding colonies of Yellow-headed Blackbirds today. A. W. Schorger (pers. comm., 1960) observed Yellow-headed Blackbirds on the University Bay marsh in the springs of 1917 and 1922. The original marsh covered about 180 acres and was drained in 1914. The present study area of nine acres is only that portion bordering the bay proper, since the remaining acreage, isolated by a road, has been cultivated for about 45 years. Since the University Bay marsh has been an important bird-observation site, we had hoped to re-establish a colony of Yellow-headed Blackbirds.

Our plan was to transfer eggs and young of the Yellow-heads[1] into the nests of the Lake Mendota Redwing colony. The Redwings could then act as foster parents and raise the young. In subsequent years, some of these young would return to the home marsh and become the nucleus for the new population.

The source of birds for this transplanting was a colony located on a 130-acre pond, known locally as Dushack's Marsh, about 15 miles northeast of University Bay, and two miles north of the city of Sun

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[1] To simplify the text and to aid in reading, the abbreviations for the Yellow-headed Blackbird and the Red-winged Blackbird will be Yellow-heads and Redwings, respectively.

TABLE 1

SUMMARY OF TRANSFER BETWEEN RED-WINGED AND YELLOW-HEADED BLACKBIRD NESTS

	1947	*1948*	*1949*	*Total*
Red-winged Blackbird				
No. eggs removed	23	23	22	68
No. young removed	29	32	49	110
Yellow-headed Blackbird				
No. eggs transplanted	18	13	9	40
No. young transplanted	33	38	52	123

Prairie. The shores of this shallow pond had two distinct cattail areas, each supporting a population of breeding Yellow-headed Blackbirds. The larger was used as a special Yellow-head study area, while the smaller served as a source of eggs and young for transplanting.

The nesting cycle of the Redwing is normally about one week in advance of that for the Yellow-head in the Dane County region. Our data show 10 June as the mean hatching date for Yellow-heads. Beer and Tibbitts (1950), working with the Redwing in this area, show 2 June as the mean hatching date.

Any proposed transfer would therefore have to take place in the relatively short periods of overlap in the respective nesting cycles. At those times the Redwing is usually feeding young while the Yellow-head is incubating. Phenological advance or retardation of the nesting cycles affects only the time of possible transfer. Other events, particularly those that destroy Redwing nests and thereby promote renesting, tend to synchronize the renesting of the Redwing with the first nesting attempts of the Yellow-head. We thought that it might be necessary to destroy first clutches of the Redwing in order to cause renesting and thus insure an adequate number of host nests. This procedure could have been done but, as it turned out, was unnecessary.

The nesting of the Yellow-head was closely watched as part of an ecological study on the larger colony at Dushack's Marsh. As soon as the first young began to appear, the University Bay Redwing colony was examined, and usable nests were marked for future exploitation.

On days during which the transfers were made, Redwing nests were located in the morning, and the Yellow-head eggs and/or young substituted in the late afternoon. The inactivity in the marsh late in the day, and night brooding of young, we felt, helped in the acceptance of transplanted young.

TABLE 2

Comparative Success of Various Types of Transfer between Nests (3 Years)

Redwings removed	Eggs 40	Eggs 28	Young 110
Yellow-heads transferred	Eggs 40	Young 23	Young 100
No. fledging	10 (26%)	25 (76%)	79 (80%)

In the three-year project (1947–1949) 68 eggs and 110 young of the Redwing were destroyed. In their places we transferred 40 Yellow-head eggs and 123 young (Table 1). Involved in the transfer were 60 nests in which the yearly success was as follows:

	1947	*1948*	*1949*	*Total*
Nests	18	19	23	60
No. successful	15	11	18	44 (73%)

Not all transfers were kind for kind, nor was the stage of the nesting cycle comparable in each case. Often it was a matter of taking any available host situation.

When we switched Yellow-head eggs for Redwing eggs, the success was poor. This was due largely to desertion by Redwing females, particularly those that had recently begun to incubate. Only 19 Yellow-head eggs hatched out of 40 that were transferred, and only 10 fledged young. Of the 13 nests in which egg-for-egg transfers were made, we had precise periods of incubation by the Redwing female in six cases. These averaged 4.5 days. To what extent this short incubation responsibility may have contributed to nest desertion, or how it altered parental behavior, we do not know. Unfortunately, we did not record most of the ages of Redwing embryos destroyed at time of transfer.

Smith (1950) introduced 43 Redwing eggs into 24 Yellow-head nests as part of a behavioral study. Of this number, 26 per cent fledged. This is the same percentage that fledged in our study where the introductions were Yellow-head eggs to Redwing nests (Table 2).

The success of Yellow-head young transferred to Redwing nests from which eggs were removed was 76 per cent (Table 2). As a possible means of insuring acceptance of the young in this premature hatching, the Redwing eggs were broken, the contents destroyed, and the egg shells placed with the Yellow-head young in the Redwing nest. This was done to simulate conditions at hatching.

By far the largest transfer was made on a young-for-young basis, 100 Yellow-heads for 110 Redwings. This type of transfer was also

the most successful, with only 20 per cent failing to fledge. In most cases of young-for-young transfers, the ages of the respective young were the same. There were several instances, however, when the Redwing young removed were twice the age of the Yellow-head transplants. There was no nest failure attributable to this age difference. In one instance, a pair of Yellow-head young that were reared by Redwings for a period of six days were about to fledge from a nest when two more Yellow-heads (age five to six days) were added to the nest. These last two birds were reared in spite of the fledging of the older two birds a week in advance of the late-arriving nest mates.

A single one-day-old Yellow-head was added to a nest containing two Redwing young of the same age. All three birds were reared and were equally healthy when they fledged.

In all, 100 young were fledged from 43 nests in the three-year period for an average of 2.3 young per nest. The average number of young per nest in a Red-winged Blackbird study (Beer and Tibbitts, 1950) in this area was 3.0 (170 young from 57 nests).

There were 16 nest failures: seven were destroyed by unknown causes; six were deserted after transfer; two were broken up by a rain storm; and one was lost to predation.

Our human cowbird-like activities also included transfers to other passerines more as a matter of expedience than experimental design. Two Catbird *(Dumetella carolinensis)* nests adjacent to the marsh in a willow thicket acted as host sites. In both cases young Catbirds were removed and Yellow-head young transferred. One pair deserted, and the other reared and fledged three blackbird young. A Robin *(Turdus migratorius)* nest with a single young was given two Yellow-head young, which were successfully reared and fledged.

The tolerance of Yellow-heads for foster young is not so pronounced as in the species mentioned above. Smith *(op. cit.)* reports that Yellow-heads will hatch Western Meadowlark *(Sturnella neglecta)* eggs but will either kill the young or fail to feed them.

The young Yellow-heads were often examined carefully by the foster parents after the transfer. The older the young, the longer it took for acceptance, although several hours was all the time generally required. In one case of desertion by the Red-winged Blackbird, it appeared as though the young had been accepted in the late afternoon following the transfer, but they were found dead in the nest several days later. The extreme difference in voice between the two species did not seem to affect the Redwing adults. The cries of hungry Yellow-head young would drown out all other bird vocalization on the marsh in the summer of 1949, when the fledging success was particularly good.

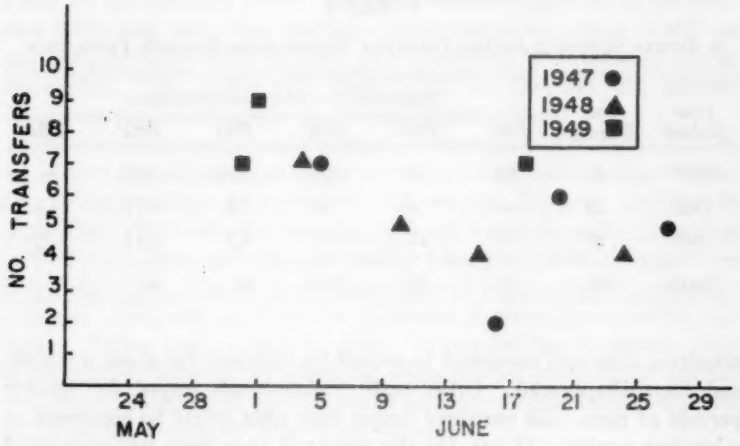

Figure 1. Time span for transfer operations during three-year period.

The time span for the 12 transfer operations involving 60 nests during the three-year period is shown in Figure 1. The earliest transfers were made in 1949, and the latest in 1947. The time of nesting-cycle overlap was shortest in 1948 (16 days).

The young Yellow-heads stayed on the marsh until late summer, when they moved daily to feeding areas with the Redwings, and eventually left the marsh at the same time as the resident birds.

RESULTS AND DISCUSSION

The techniques and mechanics of transfer of eggs and young between these two blackbirds were worked out so that the number of young fledged by the foster parents could be regarded as sufficient to consider the operation successful. This aspect, however, was only the means to an end. The end itself, namely the return of the Yellow-heads to the home marsh where they would establish themselves, was not successful.

After the experiment was concluded, several Yellow-heads returned to the marsh in four different years, but no breeding resulted.

In the spring of 1950 a male Yellow-head, apparently a young bird from the appearance of its plumage, set up a territory in the center of the University Bay marsh. He defended this area with great vigor and ardently courted all the Redwing females that came near. There were no Yellow-head females on the marsh, but he futilely attempted to

TABLE 3

A RETURN SCHEDULE FOR THE POTENTIAL YELLOW-HEAD BREEDING POPULATION

Year fledged	*No. fledging*	*Expected No. of returning fledglings*					
		1948	*1949*	*1950*	*1951*	*1952*	*1953*
1947	40	10	5	2.5	1.75	0.88	—
1948	23	—	6	3	1.5	0.75	—
1949	37	—	—	9	4.5	2.25	1.12
Totals	100	10	11	16	8	4	1

acquire a mate and continued to defend his territory for about a month, and then disappeared. Other male Yellow-heads stayed for shorter periods of time. All remained longer than what might be construed as migratory resting. If any females returned, they were not recognized or did not remain long in the absence of a Yellow-head male. In any event, we have no records of a female Yellow-head having returned to the University Bay marsh.

There are other factors that mitigate against a substantial return of young to a home marsh. Birds migrating north to breed for the first time do not "pin point" to their rearing sites as do those birds that have previously nested in a given marsh. This partial failure of first-year breeders to return to the area in which they were reared has been pointed out by Hickey (1952) using data on the Robin and Nice's (1937) data on the Song Sparrow, *Melospiza melodia*.

At the outset of the experiment we made the following assumptions: (1) that 50 per cent of the young fledged would be alive to return north the following spring; (2) that 50 per cent of these would not return to the home marsh; and (3) that an annual mortality rate on adults would be 50 per cent. At the time these assumptions seemed realistic. There were few research data available that could be of assistance.

The hoped-for results of the transfers were calculated (Table 3), using the above assumptions but not including recruitment by the breeding birds. The peak year for returning fledglings was to be 1950 when 16 were expected. Only one was observed. One added hope was that if the assumptions for our original releases were too bold, recruitment might bolster the breeding nucleus. The failure of this breeding population to materialize can be attributed largely, we feel, to the lack of "pin point homing" on the return from the wintering grounds. Our studies with other passerines not then complete indicate that the percentage returning to the home marsh is likely to be between

5 and 10 for first-year birds. Also, the estimated survival of the first-year birds may have been too high, particularly since there is still no way that mortality from fledging to 1 November or 1 January can be determined. These difficulties alone could, and probably did, account for the inadequate response of our experimental birds.

From our observations on the larger study area of Dushack's Marsh, we were reasonably sure, although we had no birds individually marked, that immature males do not breed. All females, however, appeared to be nesting. The first-year breeding by females and the lack of breeding by first-year males were also guessed by Linsdale (1938). Two of the four males that returned to the experimental marsh were in immature plumage. One male, noted earlier, defended its territory as well as any mature Yellow-head could have done. It may be that immature males in established colonies are prevented from normal breeding by aggressive mature males, thus creating bands of nonterritorial immature males and fostering polygamy among the females.

Attempts to establish a breeding population of wild birds by transferring eggs or young into the nests of another wild species have been reported by Blockley (1939), who put White Stork *(Ciconia ciconia)* eggs from Holland in nests of Gray Herons *(Ardea cinerea)* in England; by Schüz (1939) in Germany, who put eggs of the Common Gull *(Larus canus)* into nests of the Blackheaded Gull *(Larus ridibundus)* located about 500 kilometers from the Common Gull colony; and by Allen and Hickey (1940), who transferred Snowy Egret *(Leucophoyx thula)* eggs, shipped from Florida, into nests of Black-crowned Night Herons *(Nycticorax nycticorax)* in a colony on Long Island, New York.

In the case of the gull-egg transfer, there was a short period when it appeared that a breeding population might become established. All attempts including our effort with blackbirds must be considered as failures.

Summary

An attempt was made to establish a colony of Yellow-headed Blackbirds on a marsh at Madison, Wisconsin. Eggs and young from a colony of Yellow-headed Blackbirds 15 miles distant were transferred to active nests of Red-winged Blackbirds on the Madison marsh. Redwings readily accepted Yellow-head young even when the Redwing nest was in the early stages of incubation. Yellow-head eggs were not readily accepted as a substitute for Redwing eggs or young (47 per cent successful transfers). In three consecutive years the effort resulted in the fledging of 100 Yellow-headed Blackbirds. During the

five-year period following the transfers, four males returned to the marsh in which they were reared. Only one bird was observed in any one year. No Yellow-headed Blackbirds were subsequently known to have bred on the marsh.

ACKNOWLEDGMENTS

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ANALYSIS OF SYLLABLE STRUCTURE IN SONGS OF THE BROWN TOWHEE

P. MARLER AND D. ISAAC

THE new methods of analysis developed in recent years have resulted in a rapid increase in our knowledge of the physical structure of bird songs. The numerous descriptive studies now being conducted already provide us with extensive information about the ways in which songs are constructed. For the most part these studies are focused on the pattern of notes in time, and rightly so, since this provides their most effective characterization to our ears, and perhaps to the birds themselves. There is another property, detectable to our ears, but less easy to analyze physically, namely the tonal quality of the notes that comprise the song. Several authors (*e.g.*, Borror and Reese, 1956; Thorpe, 1958; Marler and Isaac, 1960a) have drawn attention to this as an important characteristic of the songs of some birds, and we must concede the possibility that a species-specific tonal quality could be important in song recognition.

With this in mind, we have made a study of the detailed physical structure of single syllables from the songs of a number of Brown Towhees *(Pipilo fuscus)*, living together in the same population. Previous study (Marler and Isaac, 1960b) has shown a high degree of variability in such characters as the number of syllables per song, syllable duration, frequency, and over-all pattern in time. In the search for more consistent characteristics, we decided to examine the overtone structure and the detailed temporal pattern of the syllables.

METHODS

As described in a previous paper (Marler and Isaac, 1960b), the recordings were made in Aguascalientes, Mexico, in July 1958, from a single population of Brown Towhees. This analysis is based on syllables selected from five different songs from one bird (B24) and from 17 songs selected from the general sample of other birds in the same area. In each case a single, typical syllable was analyzed from each song.

The selected syllables were sectioned serially by means of a slightly modified Kay Electric Company Sonagraph (Marler and Isaac, 1960), using narrow band-pass filters. The sections appear as histograms of amplitude versus frequency at intervals of 5.0 milliseconds from the beginning to the end of a syllable. As can be seen in Figure 1, a syl-

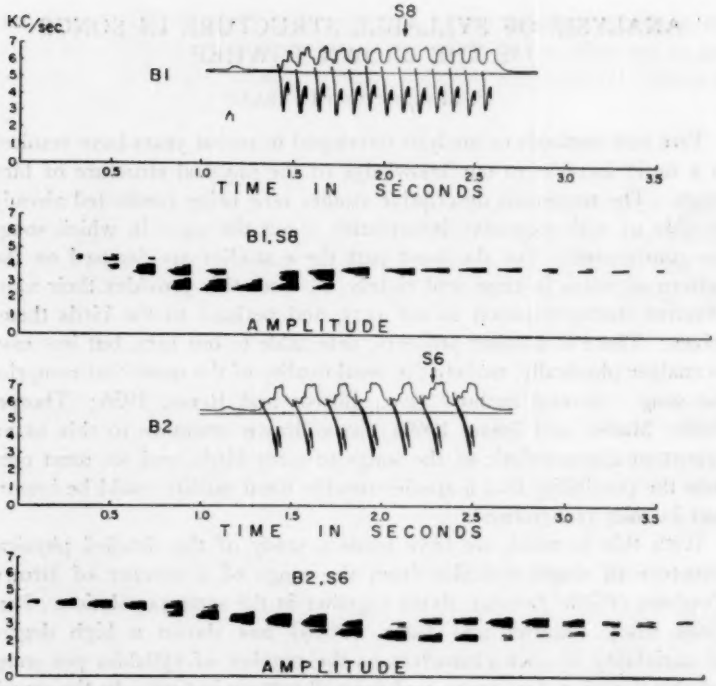

Figure 1. Two examples of the methods of analysis used in this study. Time/frequency analyses of two songs shown in B1 and B2, with a curve of maximum amplitude superimposed in each case. Introductory notes are very soft, while trill syllables all have about the same intensity, although the first one or two are a little weaker than the rest. A single syllable was selected from each song, syllable 8 in B1 and syllable 6 in B2. The series of frequency/amplitude sections from the beginning to the end of these chosen syllables are shown below in each case.

lable may be broken down into 20 or more sections. These reveal both the amplitude of the different frequencies represented at chosen moments in the syllable, and also the ways in which both frequency and amplitude change with time, in more detail than can be obtained either from the usual time/frequency analyses or from the amplitude displays. Frequency is expressed in kilocycles per second, the individual "bars" of the histograms (*i.e.*, the lines produced by the stylus of the Sonagraph) representing about 0.02 kc/sec. Amplitude is given on a decibel scale; however, since actual amplitude depends on several unknown variables, the measurements are relative and arbitrary. For

this reason amplitude values were simply measured in arbitrary units, on the linear time scale used in the frequency/time analyses.

DESCRIPTION OF SYLLABLE STRUCTURE

Frequency and amplitude characteristics. Each section has frequency as its base line, with amplitude as the other axis. For purposes of description, we have quantified the following parameters: First, it is possible to count the number of peaks in each section. All peaks that are bounded by troughs penetrating more than one third of the way to the base line are included in this estimate. Second, the frequency intervals between the highest point of adjacent peaks have been measured, in kilocycles per second. Third, the frequency of the highest amplitude peak in each section is noted. Fourth, the amplitude of the highest peak in each section has been noted, in arbitrary units. Fifth, the frequency spread of each section has been measured, this being the range from the lowest to the highest frequency in kilocycles per second. Finally, the approximate areas of all sections have been calculated by treating them either as triangles or as trapezoids and applying the appropriate formula.

In Figure 2, the total values of these characteristics for all sections of all syllables from bird 24 are compared with similar totals for all other birds together, the results being given as percentages of the totals in each case. The first point emerging is that, for the most part, the values for B24 and the general sample correspond closely. This is all the more striking when we recall the smaller size of the sample from B24 (102 sections, as compared with 273 for the general sample). If we calculate the means and standard deviations of these distributions, the essential correspondence between the single bird and the general sample is again apparent (see Figure 2). The only marked discrepancy between the two distributions is seen in the frequency of the strongest amplitude peak, which forms a fairly smooth curve for the whole sample but has two peaks in B24 at 3.2 and 4.5 kilocycles. Since B24 had only five syllable types, some of which were rather similar (see Marler and Isaac, 1960b, Figure 2), we might expect a discontinuous distribution. It is interesting to surmise in this connection that such strongly selected distribution of frequency usage could be used as information for individual identity. However, the present material is insufficient to test this idea. In spite of this difference in distribution, the mean values are identical, and the over-all variability is nearly the same.

What do the figures represented in Figure 2 tell us about the proper-

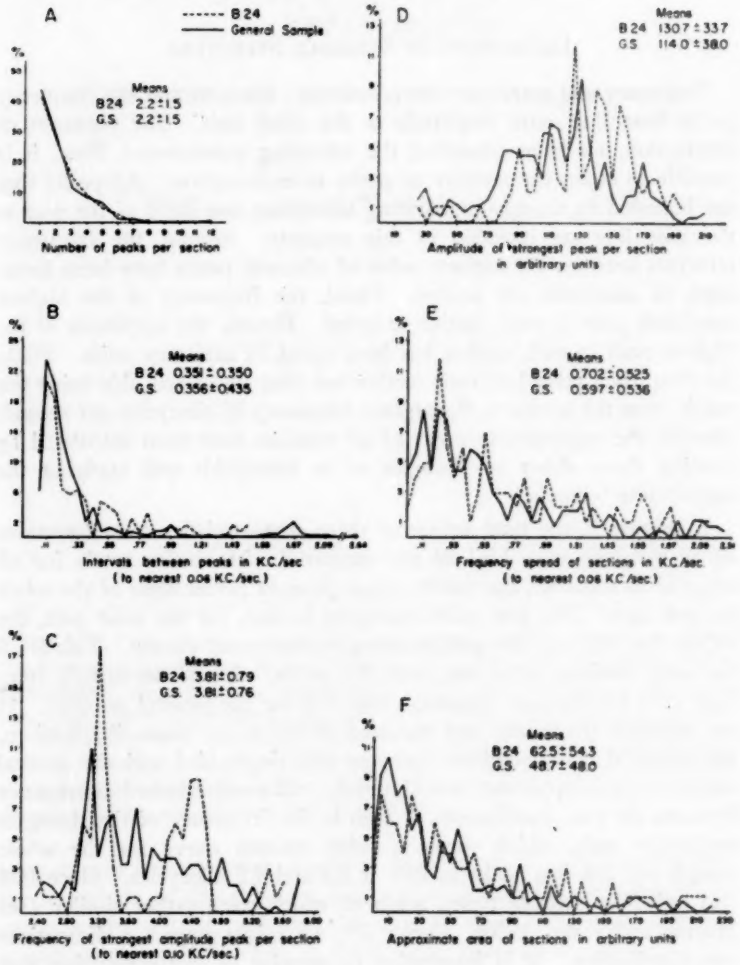

Figure 2. Distribution on a percentage basis of measurements from the sections of syllables from the songs of B24 and from syllables from 17 song types selected from the other birds. The means and standard deviations of each of the measures are also given.

ties of the syllables in Brown Towhee songs? It can be seen from Figure 2A that a large number of the sections—about 40 per cent—have only one peak, implying that in this case there are no overtones. Twenty-five per cent have two peaks, and those with more peaks become less frequent. Sections seldom have more than five peaks, the mean value being 2.2. The remainder of the graphs are concerned with that 60 per cent of the sections that have more than one peak. Figure 2B shows the interval between these peaks in kilocycles per second. The curves for both B24 and the general sample peak sharply at about 0.15 to 0.20 kc/sec. Values between 0.10 and 0.35 kc/sec. account for about three quarters of the whole sample. Thus there is a possibility of characterizing the typical overtone pattern in these syllables in a rather definite way.

However, a problem of interpretation arises, since two kinds of intervals are included in these data. In addition to true overtones, there are occasions when syllables include two distinct notes that overlap in time. If the notes have widely different frequencies, then very large intervals result. Unfortunately, it is impossible to separate these two types of intervals consistently, and for this reason the data have been lumped together. We have, however, examined the effects of eliminating all obvious cases of note overlap in the general sample.

The mean in frequency interval between amplitude peaks calculated from these revised figures for the general sample is 0.211 ± 0.131 kc/sec. as compared with 0.356 ± 0.453 kc/sec. for the original figures. There is thus a marked reduction in variability in the new estimate, suggesting a rather typical interval between overtones of about 200 cycles.

The plot of the frequency of the strongest amplitude peak (Figure 2C) has already been commented upon. While a given syllable may have a single dominant frequency, the range for the sample as a whole is very wide indeed. This is consistent with findings in other species, where absolute frequency is one of the most variable parameters. The amplitude of the highest peak is similarly variable, as we might expect, and the same is true of section area (Figure 2D and F). The distribution of the frequency spread of the sections is worthy of closer attention (Figure 2E); the tail end of the curve is affected by the overlap in time of two notes, with different frequencies, in the same way as discussed above for the interval between peaks. Thus, by elimination of obvious cases of note overlap, the frequency spread of 0.597 ± 0.536 kc/sec. is reduced to 0.469 ± 0.344 kc/sec. It is interesting to compare this with the figure for frequency spread of the entire songs obtained in a previous analysis—4.01 ± 0.92 kc/sec.

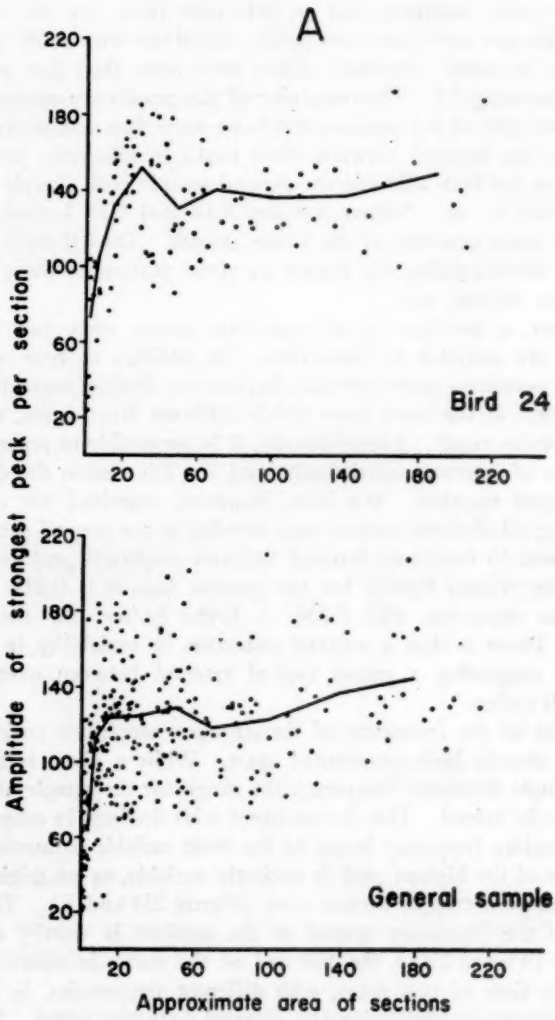

Figure 3A. Graph of the correlations between the total energy in a section, as revealed in section area, and the amplitude of the strongest peak.

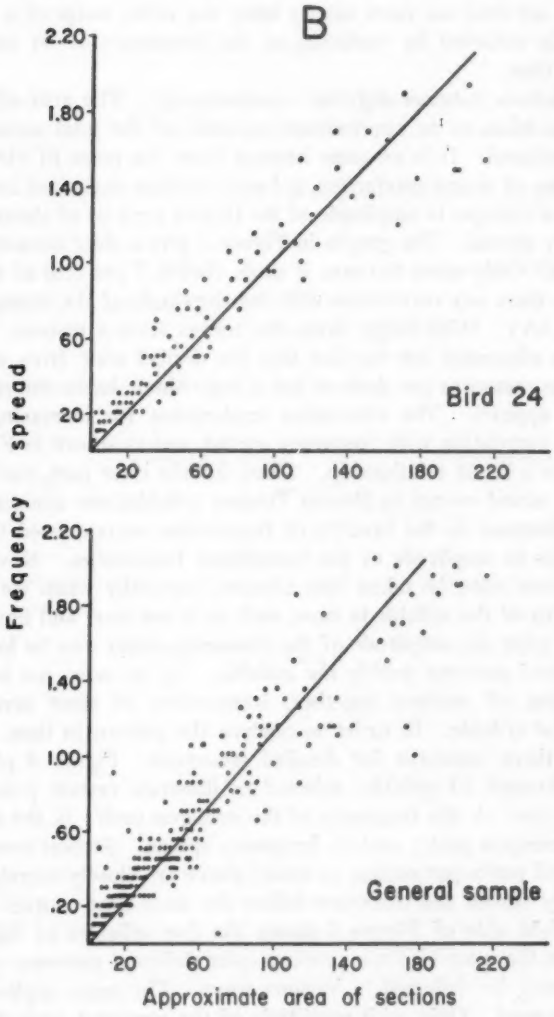

Figure 3B. Graph of the correlations between the total energy in a section, as revealed in section area, and the frequency spread.

(Marler and Isaac, 1960b). Even allowing for the fact that the latter are based on wide-band filter settings, the difference is still striking. As we shall see more clearly later, the wider range of a complete syllable is achieved by variation of the frequency of its constituent notes in time.

Correlations between different measurements. The area of the sections was taken as an approximate measure of the total sound energy being produced. It is of some interest from the point of view of the mechanism of sound production to know whether variations in area are a result of changes in amplitude of the highest peak or of changes in the frequency spread. The graphs in Figure 3 give a clear answer to these questions. Only when the area is small (below 7 per cent of the maximum) is there any correlation with the amplitude of the strongest peak (Figure 3A). With larger areas the curves form a plateau. Even if we make allowance for the fact that the decibel scale from which the amplitude measures are derived has a logarithmic basis, the same relationship appears. The alternative explanation for increasing section area is a correlation with frequency spread, and as shown in Figure 3B, they have a linear relationship. Thus, for the most part, variations in the total sound energy in Brown Towhee syllables are associated more with differences in the breadth of frequencies encompassed than with differences in amplitude of the constituent frequencies. Nevertheless, both factors must be taken into account, especially when we consider the pattern of the syllable in time, such as at the start and finish of the syllable, when the amplitude of the frequency peaks may be low.

Temporal patterns within the syllable. Up to now, we have been considering all sections together, irrespective of their arrangement within the syllable. In order to analyze the pattern in time, we have selected three measures for detailed treatment. Figure 4 plots their course through 10 syllables selected to illustrate certain points. The variables are: A. the frequency of the strongest peak; B. the amplitude of the strongest peak; and C. frequency spread. Section area and the number of peaks per section as stated above are closely correlated with frequency spread and therefore follow the same time course.

The right side of Figure 4 shows the five syllables of B24. It is clear that the same bird can produce quite different patterns. The frequency may be deflected in various ways. The same applies to frequency spread. Only with amplitude of the strongest peak do we see any sign of consistent trend for lower values at the start and finish of the song—a trend also visible in the syllables of other birds. Examination of the detailed patterns reveals a close correspondence between syllables 2 and 9 of song 33, a song that included two syllable types

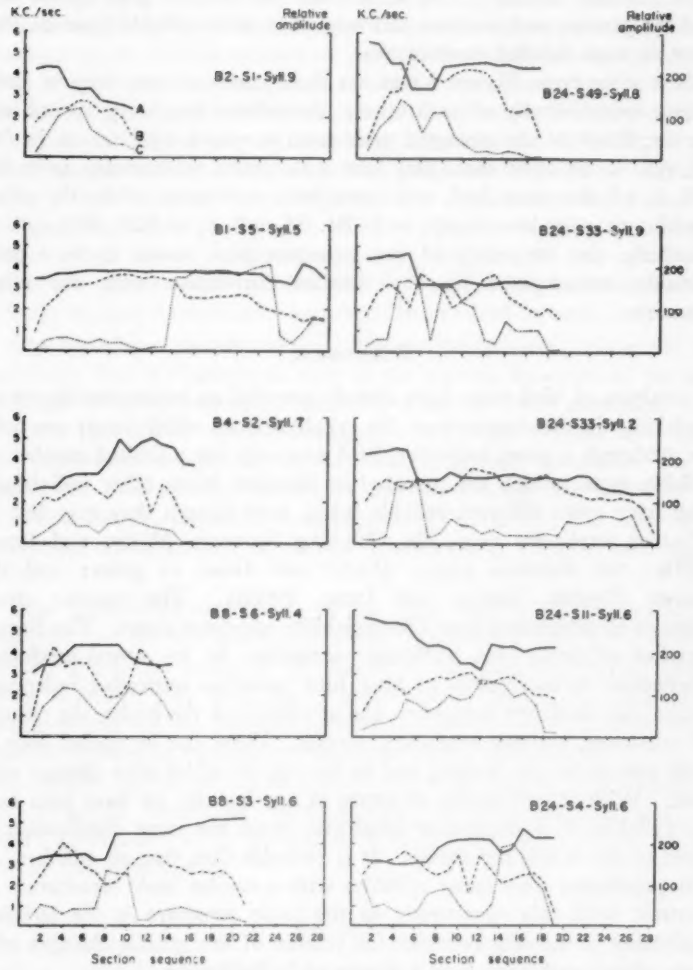

Figure 4. Diagrams of the changes taking place during the time course of 10 selected syllables: A. the frequency of the strongest peak (solid line); B. the amplitude of the strongest peak (dashed line); C. the frequency spread (dotted line).

(see Marler and Isaac, 1960b, Figure 1). It had already been deduced from the time/frequency analyses that these two syllable types were basically similar. The second one has the last part drawn out, and the present analyses bear this out. The other syllable types of B24 have no such detailed resemblance.

It is clear from Figure 4 that the three measures can vary to some extent independently of each other. Sometimes frequency spread and the amplitude of the strongest peak seem to march together, as in B8, S6, syll. 4. In other cases they have a reciprocal relationship, as in S3, syll. 6, of the same bird, and sometimes one varies while the other remains more or less steady, as in B1, S5, syll. 6, or B24, S33, syll. 2. Similarly, the frequency of the strongest peak seems to be a free variable, unhampered by any detailed correlation with the other measures.

DISCUSSION

Analyses of bird songs have already revealed an impressive degree of variability in the structure of the syllables from which songs are built up. Although a given individual bird may only use a limited number of syllable types, which are repeated in identical form, other individuals may have quite different syllable types, even though they may live in adjacent territories (*e.g.*, the Chipping Sparrow, Marler and Isaac, 1960a; the Mexican Junco, Marler and Isaac, in press; and the Brown Towhee, Marler and Isaac, 1960b). The present study helps us to understand how this variability can come about. The Brown Towhee evidently has sufficient versatility in its sound-producing mechanism to manipulate at least four variables somewhat independently: the dominant frequency, the amplitude of the peaks, the pattern of overtones, and the frequency spread. These can be varied both in their pattern at one instant, and in the way in which they change with time. With regard to the structure at one instant, we have seen how the syllables of a single individual give much the same distribution as those of the whole population. It is probable then that all members of this population were using syllables with a similar basic structure. In contrast with this consistency in the basic structure is the striking variability in the way in which the pattern of the syllable changes with time, giving each song type a degree of individuality.

One of our concerns in this study was the possibility of a species-specific tonal quality in Brown Towhee songs. Tonal quality is controlled by these variables we have been measuring, and most particularly by the pattern of simultaneous overtones. We have seen a rather striking consistency in the interval between overtones in these songs—

about 200 cycles per second—which could provide a basis for specific recognition. However, species-specificity can only be discussed against the background of sounds of other species living in the same area. At present we do not have the information necessary for this comparison. Because of the limited number of possible combinations that are available, it is not easy to imagine a number of sympatric species relying heavily for specific distinctiveness of their songs upon different patterns of overtones. When we add to this the demonstrated variability of the frequency characteristics of many bird songs and the effects of differential rates of attenuation of high and low frequencies, the chance of tonal quality alone providing a reliable basis for specific recognition seems rather remote. This is not to say that its role may not be an important one in some species, the Brown Towhee included, but in general we may expect other factors to be involved as well.

Our attention naturally turns to the pattern in time. However, we have seen that the pattern in time of the internal structure of the syllables shows great individual variation, which is hardly consistent with a prime function of specific recognition—although suitable as a basis for individual recognition, as we have suggested elsewhere. It is rather the over-all time pattern of the whole song that is likely to provide a means of specific recognition, and this does in fact have some consistent characteristics in Brown Towhee song (Marler and Isaac, 1960b).

How these different aspects of the song develop in the course of ontogeny we do not know. It seems conceivable that the overtone pattern is a direct result of the nature of the sound-producing structures, which in turn may have species-specific properties. The individual nature of the temporal pattern within the syllable could be a result of chance or random processes during the course of development. The species-specific nature of the over-all time pattern calls for some more-elaborate means of neuromuscular control, either through a genetic mechanism or by learning of a song tradition from other members of the same species.

SUMMARY

As a method of analyzing the physical basis of tonal quality, frequency/amplitude serial sections were made at five-millisecond intervals through the individual syllables of 22 Brown Towhee songs. These sections reveal an overtone structure with the interval between overtones ranging around 200 cycles per second. This overtone structure provides a possible basis for a distinctive tonal quality. Other charac-

teristics of the sections, such as number of peaks per section, frequency and amplitude of the strongest peak, frequency spread, and section area, are more variable. A search for correlations between different measures suggests that variations in total sound energy are associated more with the breadth of frequencies encompassed than with the amplitude of the constituent frequencies. Analysis of the temporal pattern within the syllables shows that frequency and amplitude of the strongest peaks and frequency spread can vary to some extent independently of each other, so providing the basis for the individual characteristics in Brown Towhee songs.

ACKNOWLEDGMENTS

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WEIGHTS OF MASSACHUSETTS QUAIL AND COMPARISONS WITH OTHER GEOGRAPHIC SAMPLES FOR TAXONOMIC SIGNIFICANCE*

THOMAS H. RIPLEY

ALDRICH (1946b) and Aldrich and Duvall (1955) have pointed out that the Bobwhite inhabiting Massachusetts and adjoining portions of the northeastern states belongs to a distinct race or subspecies, which was originally described by Phillips (1915) as *Colinus virginianus marilandicus*. Aldrich verified Phillips' contention that the northeastern subspecies is a brighter, more reddish, and larger bird. Although this subspecies is not officially recognized in the American Ornithologists' Union Check-list (1957), the writer concurs with Aldrich and Phillips in the validity of separating this race. The comparisons of weights made in this note are offered as supporting evidence of the larger size of this population, and for subspecific recognition of the form.

From 2 January to 6 May 1956, 282 quail were trapped and weighed in Barnstable County, Massachusetts. These observations serve as the basis for weight comparisons with other reported findings cited below. Although year-to-year differences in weights would occur, limited observation in other years suggests that these differences are relatively minor. Nineteen adults and 49 juveniles were trapped between 2 and 15 January (the period of greatest weight). Adults averaged 241.7 grams (S.D. 13.1); juveniles (birds-of-the-year) averaged 228.6 grams (S.D. 12.6). The maximum weight observed in this series was 265.4 grams for an adult male captured on 5 January in the township of Barnstable.

Weights of Bobwhite reported by other workers have been used for comparisons with equivalent subsamples of the Massachusetts birds (taking into account time of collection and age composition of the samples). Geographic differences have been expressed as percentages of the mean body weight of comparable collections of Massachusetts birds trapped in Barnstable County. Table 1 shows the authority, area of collection, mean weight for the series, mean weight of equivalent Massachusetts series, and weight percentage of the Massachusetts series. In order to depict these comparisons most meaningfully, the percentages given in Table 1 have been reproduced (Figure 1) on a

* A contribution of the Massachusetts Division of Fisheries and Game, PR Project 25–R.

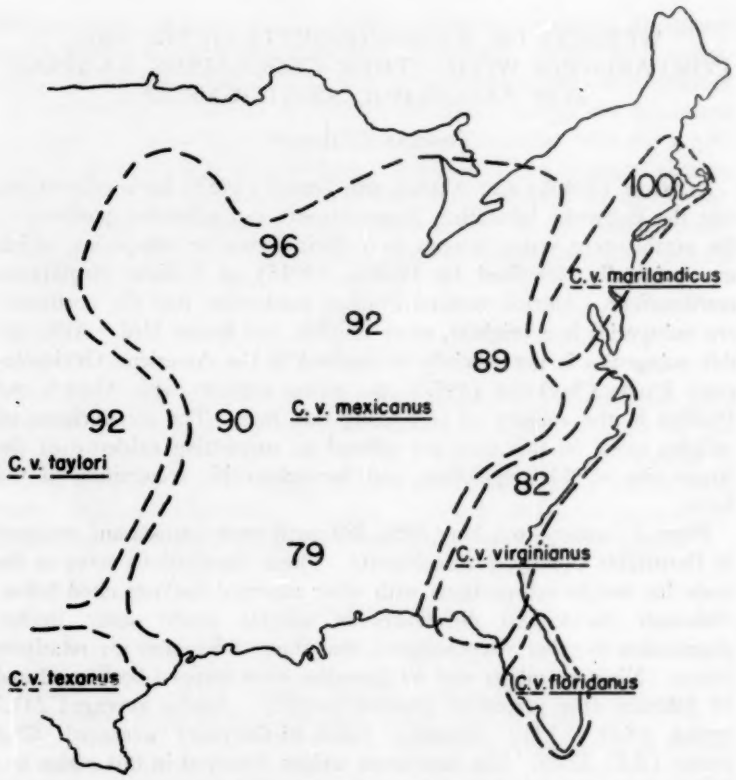

Figure 1. Comparative mean weights of different geographic samples of Bobwhites expressed as percentages of the mean weights of comparable Massachusetts samples. (Base map of subspecific ranges taken from Aldrich, 1946b.)

map published by Aldrich and Duvall (1955) showing subspecific ranges.

Matters of subspecific separation are admittedly often tenuous, but are of considerable value in the study of speciation. As Aldrich (1946a) has mentioned, where introduction and transplanting of game birds are employed, recognition of subspecies may be very important.

The cline in increasing weight northward is evident from Figure 1. The weight comparisons depicted, together with important coloration and marking differences noted by both Aldrich (1946b) and Phillips (1915), suggest differences in the northeastern birds that are as strik-

TABLE 1

COMPARISONS OF MEAN WEIGHTS OF MASSACHUSETTS BOBWHITE WITH SAMPLES FROM OTHER GEOGRAPHIC AREAS

Authority	*Area*	*Mean weight*	*Comparable mean weight Massachusetts*	*Per cent of Massachusetts weight*
Hood (1955)	Mississippi	165	208	79
Stoddard (1931)	South Carolina	176	215	82
Bailey (1947)	West Virginia	186	208	89
Leopold (1945)	Missouri	187*	208	90
Reeves (1954)	Indiana	192	208	92
Robinson (1957)	Kansas	207	224	92
Mattison (1948)	Wisconsin	202	210	96

* Approximated between 185 and 192 (juvenile-adult) by weighted representation for normal adult-juvenile ratios.

ing as those in recognized subspecies. It appears, with the addition of these weight comparisons, that there may be greater justification for subspecific recognition of *marilandicus*.

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RACES OF THE SHORT-TAILED HAWK, *BUTEO BRACHYURUS*

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In the following discussion I shall present reasons for considering *Buteo brachyurus* a polytypic species with three well-marked populations, although it can be argued that two or even three species are represented.

Buteo brachyurus Vieillot was described in 1816, and the type locality has been restricted to Cayenne. Several additional, later names have been based on South American birds and belong in synonymy. In 1858 Sclater described a small, black *Buteo* from northern Mexico as *Buteo fuliginosus,* and this name was carried in the hypothetical list of the first (1886) American Ornithologists' Union "Check-list," though as mentioned there, Ridgway had already pointed out that the identification was based on a melanistic specimen of the white-breasted bird. The name was dropped from the next (1895) "Check-list" and has remained in synonomy.

Philippi, in 1899, described *Buteo albigula* from Chile. In 1931, Peters (vol. 1, p. 229) wrote: "I can not imagine what *Buteo albigula* Philippi . . . can possibly be." Hellmayr and Conover (1949, p. 88) relegated the name to a footnote with the comment that it was unidentifiable.

However, in 1951, Goodall, Johnson, and Philippi established *B. albigula* as a Chilean species, listed six specimens, and published a photograph of an adult skin showing the characters of the underside. Stresemann (1959) pointed out that seven specimens in the British Museum (Natural History) and the American Museum of Natural History from Peru, Ecuador, Colombia, and Venezuela belonged to *albigula* and thus greatly extended its range and that 10 specimens in the British Museum and Berlin Museum from Brazil (Rio de Janeiro, Porto Alegre, Cantagallo, and Pará), Venezuela, Bolivia, Costa Rica, Guatemala, and Mexico were *brachyurus.* He also reviewed the characters of the two "species."

With Stresemann's paper in hand, it was easy to separate the South American series in the Chicago Natural History Museum into *albigula* and *brachyurus.* But it was apparent that the available birds from Florida were not the same as those from South America, although they agreed with the description of *brachyurus,* as given by Friedmann (1950, pp. 352 ff.).

To augment the series in Chicago, specimens of white-phased birds, from Middle and North America, were borrowed from the following institutions:

American Museum of Natural History (courtesy Mr. Tom Gilliard)
Carnegie Museum (courtesy Dr. Kenneth Parkes)
Louisiana State Museum (courtesy Dr. George Lowrey)
University of Cincinnati Museum (courtesy Dr. E. Kemsies)
United States National Museum (courtesy Dr. H. Friedmann)
University of Michigan Museum of Zoology (courtesy Dr. R. Storer)

To all of these my best thanks are due.

This material confirmed the impression received from the Chicago material that I was dealing with three entities. While these present a somewhat uncommon type of incipient speciation, it seems advisable to consider the three as subspecies, for reasons given below, under Discussion.

Buteo brachyurus brachyurus Vieillot

Buteo brachyurus Vieillot, 1816, Nouv. Dict. Hist. Nat., 4: 447. Type locality, Cayenne.

Diagnosis. Adult (white-breasted phase; sexes similar in color)—part of lores and forehead white, rest of upperparts usually solidly slaty black; very little of white bases of feathers show in nape; sides of head and neck solidly slaty black; a trace of rufous in sides of rump; lateral upper tail coverts distinctly barred; tail above dark gray with a broad distal and two or three narrower black bars showing beyond upper tail coverts. Underparts from chin to under tail coverts and thighs white; under wing coverts and axillaries white without or with very few markings; on underside of tail bars distinct.

Immature (light phase; sexes similar in color)—forehead with narrow, white band at most; rest of upperparts brownish black, almost black in some specimens, with much white from bases of feathers showing in nape and hindneck; sides of head and neck mixed black and buffy white; upper wing coverts and scapulars tipped with buffy; underparts and thighs white tinged buffy.

Measurements.

Wing: ♂ ad. 285, 286
♀ ad. 305, 307, 315
♂ imm. 284, 299, 303, 307
♀ imm. 307, 316, 318

Tail: ♂ ad. 142, 139
♀ ad. 150, 156, 157
♂ imm. 148, 155, 155, 159
♀ imm. 156, 163, 168

Wing-tail index (tail x 100 divided by wing):
♂ ad. 49.8, 48.6
♀ ad. 49.1, 50.8, 49.8
♂ imm. 52.1, 53.1, 51.1, 50.8
♀ imm. 50.1, 51.5, 52.8

Range. The northern two thirds of South America; up to 2,500 meters altitude and perhaps 3,000 meters; known from Brazil, Paraguay, Bolivia, Peru, Ecuador, Colombia, and Venezuela.

Remarks. One adult female from Venezuela has a small amount of rufous in the sides of the neck, the only bird so marked; another has a few blackish flecks

in the flanks, and the third has a few fine streaks in the flanks. Immature females average less white in the forehead than males, and white is practically absent in one.

Worn immatures lack the pale tips to the upper wing coverts, etc., but these worn feathers then have a pointed tip, contrasting with the rounded tip of adult worn feathers.

Although I have seen only pale-phased birds, black-phased birds are known from Colombia, from where Carnegie Museum has two specimens, according to Dr. K. Parkes (in letter), and Miller (1952, p. 451) recorded one, a female, weighing 425 grams.

Material. 12 specimens as follows: Colombia, 2 ♂ imm., 1 ♀ ad.; Venezuela, 1 ♂ imm., 1 ♀ ad.; Brazil, 1 ♂ ad., 1 ♀ ad.; Ecuador, 1 [♀] imm.; Peru, 1 ♂ ad.; Bolivia, 1 ♀ imm.; Paraguay, 1 ♂ imm., 1 ♀ imm.

Buteo brachyurus fuliginosus Sclater

Buteo fuliginosus Sclater, 1858, Proc. Zool. Soc. London, p. 356. Type locality, State of Tamaulipas, Mexico.

Diagnosis. Adult (white-breasted phase, sexes similar)—part of lores and forehead white, sometimes almost obsolete; rest of upperparts brownish black, the crown, middle of back and rump nearly uniform; scapulars and wing coverts with feathers paler and browner toward the margins; very little of concealed white ordinarily shows through on nape; sides of head solidly brownish black; sides of neck rufous brown or rufous, the feathers with dusky shaft streaks; sides of rump strongly tinged rufous; outer upper tail coverts at least strongly barred; tail above grayish brown with a broad distal black bar and three or four narrower ones (narrower than in *brachyurus*) showing beyond the upper tail coverts, these bars becoming obsolete in some specimens. Underparts from chin to tail coverts and thighs white, unmarked except for a tendency for the dark shaft streaks of the rufous brown area on the sides of the neck to extend onto the sides of the breast in many specimens, and in one specimen (a male from Florida) even onto the flanks; under wing coverts and axillaries white, almost unmarked; barring on tail seen from below indistinct to nearly obsolete.

The browner upperparts and the rufous brown in the sides of the neck are the most conspicuous color characters separating this form from *B. b. brachyurus*.

Immature (pale phase, sexes similar in color)—very like the immatures of *B. b. brachyurus* but averaging considerably browner above; and with a tendency for the streaking of the sides of the neck to extend onto the breast; in a molting female specimen from San Luis Potosi there are conspicuous streaks on the flanks, the white of the underparts is distinct to faintly tinged buffy, and a few growing scapulars have rufous edgings.

Adult (dark phase)—generally sooty or brownish black above, below, and on thigh and under wing coverts; tail as in white-breasted phase; undersurface of remiges darker and much more barred than in the white-breasted phase; feathers of nape with concealed white as in light phase.

Immature (dark phase)—above much as immature white-breasted phase; below, one specimen is heavily streaked and mottled with dark brown and buffy white; the other with brownish black and rufous. In both cases the thighs and under wing coverts are heavily patterned with dark brown.

Measurements.

Florida

Wing	♂ ad. 298, 305, 306, 313	♂ imm. ——
	♀ ad. 326, 331, 332, 332, 333, 336	♀ imm. 304
Tail	♂ ad. 162, 157, 154, 167	♂ imm. ——
	♀ ad. 172, 182, 178, 170, 165, 178	♀ imm. 164
Wing-tail index (tail x 100 divided by wing)		
	♂ ad. 54.7, 51.3, 50.2, 53.3	♂ imm. ——
	♀ ad. 52.7, 54.9, 53.6, 50.0, 49.5, 52.9	♀ imm. 53.9

Mexico

Wing	♂ ad. 282, 284	♂ imm. 274, 290, 302, 305
	♀ ad. 332	♀ imm. 315, 316, 335
Tail	♂ ad. 142, 148	♂ imm. 145, 156, 169, 154
	♀ ad. 178	♀ imm. 160, 172, 179
Wing-tail index		
	♂ ad. 50.0, 52.8	♂ imm. 52.9, 53.7, 55.9, 50.4
	♀ ad. 53.6	♀ imm. 50.7, 54.4, 53.4

Central America

Wing	♂ imm. 270, 290
	♀ imm. 312
Tail	♂ imm. 145, 150
	♀ imm. 164
Wing-tail index	
	♂ imm. 53.7, 51.7
	♀ imm. 52.5

Range. Central America, southern and eastern Mexico, and peninsular Florida; known from Panama, Costa Rica, Nicaragua, Honduras, Mexico, and Florida; and ranges up to 6,500 feet (about 2,000 meters) altitude in Michoacan (Davis, 1953, p. 90).

Remarks. In the adult, individual variation in addition to that mentioned above involves the underparts, which are tinged buffy in one specimen, and in several specimens the thighs are more or less buffy to ochraceous. One female, with ochraceous thighs, has the under wing coverts ochraceous. In females the brown of the side of the neck averages duller, less rufous than the males, but this is not constant. In one female and two males (all from Mexico) the feathers of hindneck and foreback are edged with the same rufous as the sides of the neck, giving a distinctive band. In two specimens (1 ♂, 1 ♀ from Florida) the barring on the central tail feathers has about disappeared except for the distal band. Another variant is discussed beyond under Intergradation.

The Mexican adults differ from Florida adults (pale phase) in the rufous of the hindneck as mentioned above, and the greatest size in the species is reached by Florida birds. However, the whole case is too interesting and too little known merely to name the Florida bird.

Material. Twenty-three specimens (4 adults in dark phase, 8 adults in white-breasted phase; 2 immature in dark phase, 9 in pale phase), as follows:

Florida	9 ad., 1 imm. (February, March, April, October)
San Luis Potosi	1 ad., 2 imm. (April, May, September)
Tamaulipas	1 imm. (February)
Veracruz	1 ad. (April)
Michoacan	1 imm. (dark phase) (July)

Guerrero	1 ad. (December)
Yucatan (Merida)	2 imm. (March)
Quintana Roo (Cozumel Island)	1 imm. (January)
Honduras	1 imm. (May)
Costa Rica	1 imm. (June)
Panama	1 imm. (June)

Buteo brachyurus albigula Philippi

Buteo albigula R. A. Philippi, 1899, Arch. Naturg., 65, Bd. 1: 170. Type locality, Valdivia Prov., Chile.

Diagnosis. Adult (sexes similar)—a small area in lores and side of forehead white; rest of upperparts blackish brown, the crown, middle of back and rump nearly uniform; scapulars and upper wing coverts with darker centers and becoming paler brown toward the margins; concealed white in bases of nape feathers present; sides of head nearly solid dark brown, very lightly streaked with whitish; sides of neck rufous brown or rufous, the feathers with dark shaft streaks, sides of rump with a small amount of rufous; at least outer upper tail coverts strongly barred; tail above brownish gray with a broad distal band and five or six narrower, lightly defined bars showing beyond the upper tail coverts. Underparts white with the rufous brown of sides of neck continuing over sides of breast and flanks in nearly solid bands; upper breast and upper abdomen with plentiful to sparse streaks of dark brown or rufous; thighs barred rufous; under wing coverts and axillaries fairly plentifully marked with rufous; tail seen from below with bars very indistinct.

Immature—very similar to the adult but semiconcealed white in base of nape feathers more plentiful; sides of head and neck plentifully streaked with white; white of underparts heavily tinged ochraceous; the dark brown areas from side of neck to sides of breast and flanks more broken with white and both these and the streaking of upper breast and upper abdomen lacking any rufous; thighs irregularly marked with dark brown, and under wing coverts marked with dark brown.

Measurements.

Wing	♂ ad. 272, 313	♂ imm. 300
	♀ ad. 303	♀ imm. 315
Tail	♂ ad. 157, 181	♂ imm. 188
	♀ ad. 179	♀ imm. 193
Wing-tail index		
	♂ ad. 57.7, 57.8	♂ imm. 62.6
	♀ ad. 59.0	♀ imm. 61.2

Range. Western South America; known from Chile, Peru, Ecuador, Colombia, and Venezuela; above 7,200 feet (about 2,100 meters) altitude.

Remarks. In two of the adults (1 male, 1 female) there is a tinge of rufous in the margins of some scapulars. The remaining male has the rufous of the sides of the neck continued as a faint band across the hindneck and foreback, by the feathers there having narrow, rufous margins.

Material.

Colombia:	1 ♀ ad., 1 ♀ imm. 1 sex? [= ♂] imm.
Ecuador:	1 ♂ ad.
Peru:	1 ♂ ad.

DISCUSSION

The South American *brachyurus* and *albigula* are quite readily separated by color and by proportion, and I have seen no evidence of intergradation between them. The Middle and North American *fuliginosus*, however, bridges much of the gap between the distinctive characters of the two South American forms. This is well shown by the data tabulated in Tables 1 and 2.

TABLE 1

COMPARISON OF CHARACTERS OF ADULT *brachyurus*, *fuliginosus* AND *albigula*

	Comparisons of adults (males and females)		
	brachyurus (light phase)	*fuliginosus* (light phase)	*albigula*
Upperparts	slaty black unpatterned	dark brown slight pattern	dark brown slight pattern
Tail bars	quite distinct coarse	distinct to obsolete finer	somewhat distinct finer
Sides of neck	black (usually)	rufous brown	rufous brown
Rufous tinge in side of rump	slight	strong	slight
Underparts	white unpatterned	white unpatterned (usually)	white, with distinctive pattern
Thighs	white unpatterned	white unpatterned (usually)	barred
Under wing coverts	white mostly unpatterned	white mostly unpatterned	white, heavily patterned
Wing length	285–315	282–332[1] 298–336[2]	272–313
Tail	142–157	142–178[1] 154–182[2]	157–181
Wing-tail index	48.6–50.8	50.0–53.6[1] 49.5–54.9[2]	57.7–59
Phases	light phase only except in Colombia where dark phase occurs	light and dark phase equally common in Florida	only a light-breasted phase known

B. b. fuliginosus agrees with *albigula* in white, unpatterned underparts, thighs, and under wing coverts; it agrees with *albigula* in the color of the upperparts, and barring of tail; in the rufous being restricted to side of neck and in the wing-tail index it is intermediate.

[1] Mexico specimens.
[2] Florida specimens.

TABLE 2

COMPARISON OF CHARACTERS OF IMMATURE *brachyurus, fuliginosus,* AND *albigula*

	Comparisons of immatures (males and females)			
		fuliginosus		
	brachyurus	*pale phase*	*dark phase*	*albigula*
Upperparts	brownish black	blackish brown	blackish brown	blackish brown
Underparts	buffy white, unpatterned	buffy white, unpatterned	Heavily patterned, buffy and dark brown, or rufous and fuscous	buffy white, distinctly patterned
Thighs	buffy white unpatterned	buffy white unpatterned	heavily patterned	patterned
Tail barring	coarser	finer	finer	finer
Wing	284–318	274–335[1] 304[2]	302, 316[1]	300, 315
Tail	148–168	145–179[1] 164[2]	169, 172[1]	188, 193
Wing-tail index	50.1–53.1	50.7–53.7[1] 53.9[2]	54.4, 55.9[1]	61.2, 62.6

Pale-phase *fuliginosus* agrees much better with *brachyurus* except for the tail barring and paler back; dark-phase *fuliginosus* agrees better with *albigula* though the pattern below is heavier. In wing-tail index *fuliginosus* is more like *brachyurus.*

[1] Mexico.
[2] Florida.

Before discussing the possible relationships of the three forms, it is advisable to touch on certain other aspects.

Color phases. When *Buteo brachyurus* was used as a designation for all the birds discussed above, at least three "color phases" seemed to be represented. But with the recognition of the three entities outlined above, each one is seen to show relatively little individual variation. *B. b. albigula* has only a "normal" adult and immature plumage; *fuliginosus* has a white-breasted and a dark, melanistic adult plumage and a white-breasted and a dark, patterned (approaching a "normal"?) immature plumage. Only in Florida is there any quantity of data concerning frequency of the two phases, and this indicates that the melanistic and the white-breasted phase occurs in about equal numbers (56 light-breasted to 64 dark-phased birds; Moore *et al.,* 1953, p. 472). In *brachyurus* the white-breasted phase is the common, widespread phase, but the melanistic phase is known from Colombia and may well occur elsewhere.

As might be expected, a hundred years ago the dark- and light-breasted birds were thought to be two species, and this point of view persisted for nearly 40 years. The composition of pairs reported in Florida is as follows: both of pair light, 3; both of pair dark, 10; mixed pair, 5 (Moore *et al.*, 1953, pp. 471, 472; some but not all of these "pairs" were proved to be breeding). There are no data on the color phases of broods of young.

Soft parts. Apparently the bill is black, cere yellow, and feet yellow with black nails in all three forms, although certain old specimens of both *fuliginosus* (from Florida) and *brachyurus* have some yellow in the base of the lower mandible in the adult and immature.

There is general agreement that the iris is brown in *fuliginosus*. However, in *brachyurus*, while five of the specimens I have seen are labeled iris brown, one adult has the iris labeled yellow (Merida, Venezuela, coll. Gabaldon). Of *albigula* we have three specimens from Colombia collected by K. v. Sneidern in which the iris is labeled "yellow-grey," "light brown," and "brown-yellow." V. Sneidern's specimens of *brachyurus* were labeled as having iris brown. Perhaps there is a difference in eye color among the forms.

Abundance. The short-tailed hawk *(fulginosus)* is rare in Florida, where L. A. Stimson saw it only 14 times in 214 days afield in the 20-year period 1932–1951; *i.e.*, a bird about every 14 days (Moore *et al.*, 1953, p. 476). Both *brachyurus* and *albigula* are also rare in South America, for the Chicago Natural History Museum has only 14 specimens, the earliest collected in 1906. To make this figure more meaningful, the following data on some other South American species of *Buteo* in Chicago Natural History Museum (from Hellmayr and Conover, 1949) are presented:

Buteo polyosoma	28	specimens	
poecilochrous	16	"	
leucorrhous	7	"	
fuscescens	16	"	
albicaudatus	15	"	(S. America only)
albonotatus	2	"	(S. America only)
nitidus	23	"	(S. America only)
platypterus	27	"	(winter visitors from S. America only)
magnirostris	165	"	(S. American only)

It is an axiom that predators are fewer in numbers than their prey; thus we expect hawks to be relatively scarce. But some are evidently much scarcer than others. Habits, such as wariness, may affect our knowledge of apparent rareness. Among the other factors involved may be differences in food habits and the abundance of this food.

From the little we know of *B. brachyurus,* a rare species, it may specialize in birds. *B. magnirostris,* a common species, has a much more diversified diet in which insects bulk large. *B. platypterus* has a diet consisting in large part of mammals, reptiles, and amphibians.

Habitat. Only for Florida *fuliginosus* is there much habitat data. There mangrove and lowland cypress swamp are the usual habitat, and of the 12 recorded nests at least seven were in cypress swamps and two in mangroves (Moore *et al.,* 1953, p. 475). In Chile *albigula* is said to prefer woodland to open country (Goodall *et al.,* 1951, p. 42).

Habits. So little is known about the habits that the only comment possible here is that a Florida specimen of *fuliginosus* was reported as having eaten a small hawk, *Accipiter striatus* (Howell, 1932, p. 181); a Mexican specimen had a small bird in its stomach (Davis, 1953, p. 90); a Panama specimen had the remains of a bird in its stomach while it was devouring a 14-inch ground lizard, *Ameiva* (Hallinan, 1924, p. 311); a Florida bird was seen carrying a small mammal and eating it on the wing (Moore, 1954, p. 106); a Peru specimen of *albigula* had eaten a large thrush (Zimmer).

Possibly these birds may specialize in eating birds, a rather surprising diet for a small *Buteo,* but they do have heavier feet and longer claws than does the broad-winged hawk, *Buteo platypterus,* for instance.

Range. Fuliginosus ranges from Panama to southern and eastern Mexico and Florida. The highest altitude recorded on our specimens is 6,000 feet (Guerrero). *Brachyurus* ranges in the lowlands of the central and northern parts of South America, and up into the mountains, according to our data, reaching at least to 6,000 feet in Colombia, and ? 3,000 meters in Venezuela; Stresemann (1959, p. 339) gives an altitude of 2,500 meters (Venezuela).

Albigula is an Andean bird only, ranging from Venezuela and Colombia south to Bolivia and Peru, apparently at higher altitudes than the range of *brachyurus,* and to Chile where *brachyurus* does not occur. Our lowest altitude for *albigula* is 7,200 feet in Colombia. Stresemann (1959, p. 339) gives altitudes of capture at 3,000 meters (Venezuela) and 8,850 and 10,500 feet in Peru and Ecuador.

The most reliable data from an area where the ranges of *brachyurus* and *albigula* approach each other are from K. von Sneidern's collecting in Colombia, in Cauca; Cerro El Tambo, Munchique, in 1936 and 1937. He sent us three specimens of *brachyurus* from this locality collected 3 September 1936, 27 March and 16 August 1937, and labeled 4,700, 5,100, and 6,000 feet; and three specimens of *albigula* from the same locality collected 18 May 1938, 22 June and 21 July 1937, labeled 6,900, 7,200, and 7,500 feet.

From these data I think it justifiable to assume that *albigula* and *brachyurus* are indeed altitudinal representatives.

Migration. Two suggestions of migration have appeared in the literature. Moore *et al.* (1953, p. 471) have pointed out that *fuliginosus* has not been recorded in June, nor in July in Florida, and there are only two August records, and four for May. The other 119 records of the bird for Florida are in the eight-month period, September to April. In summer birds seem to disappear from the area after the nesting season. Whether they change their habits or actually move elsewhere remains to be discovered.

For Costa Rica, Carriker (1910, p. 458) had only two records of specimens, in August and September, and suggested that the birds *(fuliginosus)* might be only winter visitors. However, I have a June specimen from Costa Rica, and the winter months comprise the period when the birds breed in Florida. Their apparent absence from Florida in summer would not agree with their being winter visitors only to Costa Rica.

The Central American and Mexican specimens that I have seen were taken in January (1), February (1), March (2), April (2), May (2), June (2), July (1), September (1), October (1), December (1), which does not suggest any seasonal movement.

Further, the three adult Mexican specimens I have seen, taken in April and December, have plumage characteristics, notably the rufous tinge in the hindneck, which I did not find in pale-breasted Florida birds. This observation also refutes the idea that Florida birds migrate to Mexico.

Intergradation. Although the above three populations, *brachyurus, fuliginosus,* and *albigula,* are amply distinct to consider ranking them as species, and *brachyurus* and *albigula* are not known to intergrade, the three form a graded series with *fuliginosus* as the intermediate (see Tables 1 and 2). Even the barred thighs and under wing coverts and patterned underparts of *albigula* find their counterpart in the barred thighs and under wing and patterned underparts of the dark-phase, immature specimens of *fuliginosus.*

The close relationship of these three forms is indicated further by the individual variation as illustrated by the following specimens.

(a) A *brachyurus* adult (University of Michigan No. 12262) from Venezuela is the only one of the five adults that has rufous brown on the sides of the neck. In this it resembles *fuliginosus* but differs in the other characters as listed.

(b) A *fuliginosus* pale-phase adult from Mexico (University of Michigan No. 100176) differs from the other seven specimens in being nearly as blackish above as the five *brachyurus.* However, it otherwise resembles *fuliginosus.* In having

rufous edgings to the feathers of the hindneck, it has a character that I have seen elsewhere only in the other two adults from Mexico, and in two of the three *albigula* adults.

(c) A female pale phase of *fuliginosus* from San Luis Potosi (Louisiana State University No. 16720) I tentatively consider an immature molting into adult plumage, but it may be a molting adult. It is the most puzzling bird of the whole series. Despite its immaculate thighs and low wing-tail index, it has several growing scapulars that are fringed with rufous, a character that otherwise I found only in two of the three adult *albigula*. The rufous patch on the sides of the neck shows on the new feathers; the feathers of flanks and sides of the breast have conspicuously fuscous shaft streaks, and there are a few well-defined dark shaft streaks on the upper breast and on the upper abdomen. Because of its streaked underparts and rufous scapulars, this bird looks like an adult *fuliginosus-albigula* intermediate.

Relationships of the three forms. The three populations discussed above seem to be more closely related among themselves than to any other member of the genus *Buteo*. If the distribution of these three forms were different, arranged in a lineal sequence, or on three islands, with the form intermediate in characters in a geographically intermediate position, I think there would be little question that the three would be called subspecies.

Since the two most different forms seem to be altitudinal representatives in South America, and intergradation is unknown there as yet, one might elevate these to species rank, as Stresemann has done. The intermediate Middle and North American form then could be called a separate species, or attached to either of the species as a subspecies.

However, the intermediate character of the northern form seems best expressed by writing the three as one species with three well-marked races, despite the somewhat unusual distribution. How this situation came about is difficult to picture. From its present distribution the group is certainly a tropical one. The subtropical elements of the South American avifauna in general have developed from tropical, lower altitudinal forms. However, since the connecting link between the two South American forms is to the north, one assumes that colonization and recolonization have taken place. One could postulate with little conviction that character displacement has been a factor in causing the greater difference between the two South American forms.

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AUTUMN WEIGHTS OF BLUE GEESE *(CHEN CAERULESCENS)*

F. G. COOCH, G. M. STIRRETT, AND G. F. BOYER

EACH autumn since 1952, the authors have been engaged in bag checking along the coast of James Bay and as a result have handled a sample of 2,870 Blue Geese *(Chen caerulescens)*.

Data used in this discussion were obtained by weighing geese on a spring balance, calibrated with standard weights. Dead birds were weighed by inserting the hook of the balance through the nostril, while live birds were placed in a net bag suspended from the hook. All weights were recorded to the nearest quarter pound. More precise measurement would contribute little, because of variation in crop content, wetness of feathers, and interval since the birds were shot.

The sex of each bird was determined by eversion of the vent, using the method described by Elder (1946) to detect the presence or absence of the penis.

In addition, the sample was divided into three age categories: (a) adult; (b) subadult or yearling; and (c) immature or juvenile. The division is easily accomplished on the breeding grounds, but is more difficult to do in James Bay where subadults closely resemble breeding-age adults. As late as October, however, most subadults still commonly exhibit a nail that is incompletely defined along its proximal margin, minor plumage differences, and frequently retain black patches on the bill. All of those characters are lacking in fully developed adults. In addition, the penis of a subadult male is incompletely sheathed and smaller than that of a breeding male. Most subadult females retain the bursa of Fabricius and a closed oviduct. Black feathering, extending along the nape and occasionally extending to the crown and cheeks, cannot be used as a criterion of immaturity in either sex. Females having the appearance of typical subadults have been recorded incubating on the breeding grounds (Cooch, 1958). Incubating birds captured at Boas River, Southampton Island, in 1952 and noted as retaining the melanistic pattern were color-marked and sketches made of the degree of melanism. Twenty-one birds recaptured in 1953 showed no decrease in melanism. Immature blue-phase *caerulescens* are readily distinguishable from all other categories because of their dark heads and bills, yellow chin patch, and black feet; white-phase immatures are characterized by gray feet and bills, plus a generally dirty appearance, especially on the greater wing coverts and scapulars.

Most published data on the weights of game birds are based on samples taken during the hunting season. In order to make the present data more readily comparable with those previously published for other waterfowl, weights of Blue Geese taken in the period 10 September through 15 October are presented in Table 1. Since those weights were taken over a seven-year period, they cannot be used for comparative data on sex and age distribution. The difference between mean weights of males and females is significant at the 5 per cent level.

Although Table 1 is derived from a sample of 2,870 geese, it does not exhibit the variation in weights that exists from year to year. Data are available that indicate that the autumn weight of Blue Geese in James Bay is dependent upon breeding phenology and the date at which the postnuptial molt ended. The nest-initiation period of the Blue Goose is unusual because of its shortness (10 days; cf. Cooch, 1958). Thus if the date of first laying is delayed a week or 10 days, juveniles shot in James Bay would on the average be a week or 10 days younger, and thus lighter. The date of the postnuptial molt of successful breeding adults is delayed in retarded seasons, but that of subadults and failed-breeding adults occurs at about the same time each year. Dates of first nesting during the present study have been 4 June 1952; 9 June 1953; 14 June 1954; 6 June 1955; 12 June 1956; 16 June 1957; 12 June 1958; and the average, 10 June. Comparative data on the annual variation in weights for the period 1–10 October are given in Table 2.

The relationship between weight of juvenile geese and date of nest initiation was tested by linear regression and correlation. Both negative regressions are significant at the 5 per cent level. Figure 1 demonstrates clearly the futility of gathering weights in a single season and assuming that they are always representative, regardless of the phenology of the season.

Weights of subadults do not vary significantly from year to year, since the timing of their molt is not dependent on the date of nest initiation. They may be affected by delays in the appearance of new vegetation and the date on which they were hatched in the previous year.

After their arrival on the breeding grounds, adult males undergo a 17 per cent weight reduction as a result of activities associated with reproduction. Unlike data from juvenile birds, data from adult males taken in James Bay do not show a significant variation among years, since varying proportions of adult birds that did not breed successfully are included in each year's sample. Nonbreeding individuals have more time in which to regain weight after the postnuptial molt. In retarded seasons the proportion of birds in that category is large, which in turn tends to elevate the mean weight of geese in the sample.

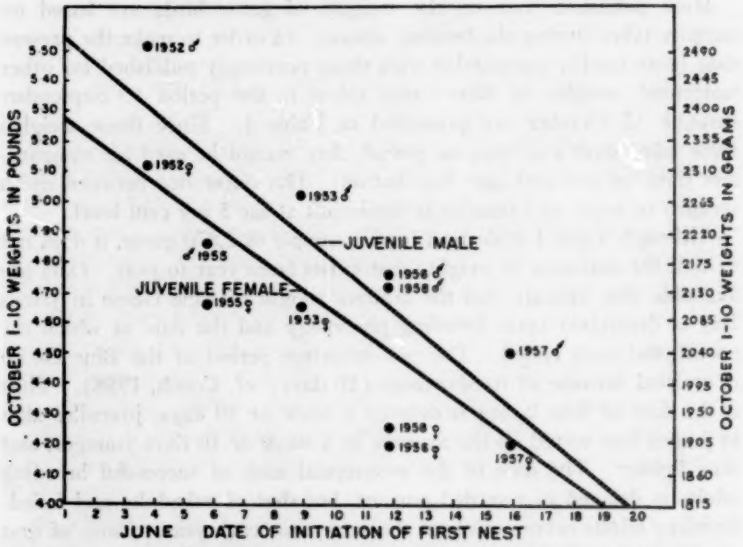

Figure 1. Regression showing relationship between autumn weight of immature *Chen c. caerulescens* and June date of nest initiation.

An interesting situation is noted in mean weights of adult females that normally exhibit a 25 per cent reduction in weight as a result of nesting activities. If their clutches are destroyed, they follow the same sequence as described for failed-breeding males. If the season is somewhat successful, but retarded, weights of this category will tend to be greatly reduced, unless the proportion of failure is great. Weights of adult males are not so greatly depressed because of food consumed while their mates are incubating. The successful female, however, has, in very retarded seasons, little opportunity to regain weight before leaving for James Bay.

Only one difference has been noted in weights of blue-phase and white-phase geese: in very retarded seasons, weights of juvenile white-phase geese are less than blue-phase geese of similar age and sex. Some have soft primaries as late as 10 October and weigh less than four pounds. These small, retarded geese may originate from breeding areas far to the north of those generally used by blue-phase birds, or may be late-hatched birds from a mixed brood.

The Blue Geese that stop in some autumns in South Dakota and other midwestern states breed on Southampton Island, northern Baffin Island,

TABLE 1

WEIGHT IN POUNDS AND GRAMS—10 SEPTEMBER–15 OCTOBER 1952–58

Weight		*Immature*		*Subadult*		*Adult*	
Gms.	*Lbs.*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*
1361	3.00	6	2				
1474	3.25	7	5				
1587	3.50	27	13				
1701	3.75	63	32	1			
1814	4.00	84	54	5	2	1	
1928	4.25	106	91	5	5	2	
2041	4.50	136	129	11	6	9	
2155	4.75	90	126	21	8	25	3
2268	5.00	60	136	40	23	36	12
2381	5.25	28	109	58	25	78	25
2595	5.50	14	73	51	33	91	66
2608	5.75	6	35	37	37	82	74
2721	6.00	3	16	22	48	53	88
2835	6.25		6	12	26	27	74
2948	6.50		3	6	18	12	59
3061	6.75		1	1	9	3	41
3175	7.00		1		8	3	15
3288	7.25				1		7
3402	7.50						3
N		630	832	270	249	422	467
Mean	(lbs.)	4.40	4.80	5.35	5.73	5.55	6.05
	(gms.)	1996	2177	2427	2599	2517	2744
S.D.	(lbs.)	.525	.597	.527	.632	.479	.519
	(gms.)	238	271	249	287	217	235

and at Eskimo Point. Variations in breeding phenology affect not only weight but also apparently have a pronounced effect on the autumn mortality of Blue Geese.

The existence of a relationship between the date of nest initiation, mean weight, and the nature of the autumn migration has wide implications for the study of many species of waterfowl nesting in the Arctic. Its application to species capable of renesting will be difficult, but should eventually prove feasible.

SUMMARY

The weight of Blue Geese in autumn is dependent on the phenology of the breeding season. A short delay in the start of nesting causes significant decreases in the autumn weight, especially of immature birds. Subadults and failed-breeding adults show little annual variation, whereas successful breeding adults, particularly females, follow the same pattern as the juvenile cohorts.

TABLE 2

ANNUAL VARIATION IN WEIGHT OF BLUE GEESE TAKEN IN JAMES BAY, 1–10 OCTOBER 1952–1958

	Adult						*Subadult*						*Juvenile*					
	Male			*Female*			*Male*			*Female*			*Male*			*Female*		
Year	*N*	$\overline{M}$	*S.D.*	*N*	$\overline{M}$	*S.D.*	*N*	$\overline{M}$	*S.D.*	*N*	$\overline{M}$	*S.D.*	*N*	$\overline{M}$	*S.D.*	*N*	$\overline{M}$	*S.D.*
1952	20	2867	242	18	2585	247	2	2781	—	2	2781	—	37	2595	273	38	2341	164
1953	49	2790	189	36	2567	174	25	2781	224	22	2604	199	106	2263	226	103	2109	169
1954	33	2744	219	22	2527	207	10	2595	177	12	2354	188	—	—	—	—	—	—
1955	39	2672	248	42	2559	209	13	2626	210	18	2490	158	89	2191	249	88	2118	254
1956	48	2872	211	46	2617	185	18	2676	253	11	2585	193	79	2150	271	71	1900	189
1957	31	2676	224	32	2472	185	10	2676	240	15	2404	207	64	2059	272	54	1905	231
1958	22	2849	244	21	2353	197	39	2731	209	38	2449	200	57	2136	228	62	1928	236
Total	242	2767	218	218	2549	204	117	2699	243	118	2490	214	432	2200	277	416	2041	258

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PENGUIN TRACKS FAR INLAND IN THE ANTARCTIC

W. J. L. SLADEN AND N. A. OSTENSO

THE breeding places of Antarctic penguins are along the coast. These truly aquatic birds are known to travel great distances at sea, but there are very few records of wanderings inland. Wilson (1907: 57) mentions that Adelie Penguins, *Pygoscelis adeliae*, have been seen on the Ross Ice Shelf, about 110 kilometers inland from the sea. Recently, a fairly well-preserved carcass of an Adelie Penguin was found lying on bare ground 24 kilometers from the sea near mummified Crabeater Seals, *Lobodon carcinophages*, in the McMurdo Sound area (Péwé, Rivard, and Llano, 1959).

The present paper reports on two penguin tracks that were found, within a day of each other, by two U.S. traverse teams during the International Geophysical Year, 1957–1958. One track was about 300 kilometers (186 miles) and the other about 400 kilometers (250 miles) from the nearest known sea.

The first was seen on 31 December 1957 by N. B. Augenbaugh, who was a member of the Ellsworth Station traverse party traveling on the Filchner Ice Shelf. At approximately 67°00′W, 78°50′S, and at an elevation of about 61 meters (200 feet), the party came across an indistinct track in the snow. Photographs convinced us that it was made by a walking penguin (Figure 1). Although positive identification was not possible, the track was most likely made by an Emperor Penguin, *Aptenodytes forsteri*. The track was running east-west; however, the direction of the bird could not be ascertained. This bird was over 400 kilometers from the known edge of the Filchner Ice Shelf and about 500 kilometers from the nearest (and recently discovered) Emperor rookery in Gould Bay farther southeast (Figure 3).

The second observation was made on 1 January 1958 during the Byrd Station traverse. When traveling on the Ellsworth Highland, between Kohler Range and the Sentinel Mountains, at 77°30′S, 98°54′W, and at an elevation of 1,440 meters (4,720 feet), the party crossed a recently made penguin track in the snow (Figure 3). The bird was heading South 20° East *true* in a remarkably straight line. The track was followed for about 2 kilometers, and over this distance it showed less than a 2° deviation in direction. The bird had walked for only two meters; for the rest of the way, it had tobogganed on its belly. The size of the footprints was 8 x 5 cm. and the standing stride 30 cm. The width of the groove caused by the breast of the tobogganing bird was 6 to 9 cm. When tobogganing, a penguin propells itself with its feet. The distance

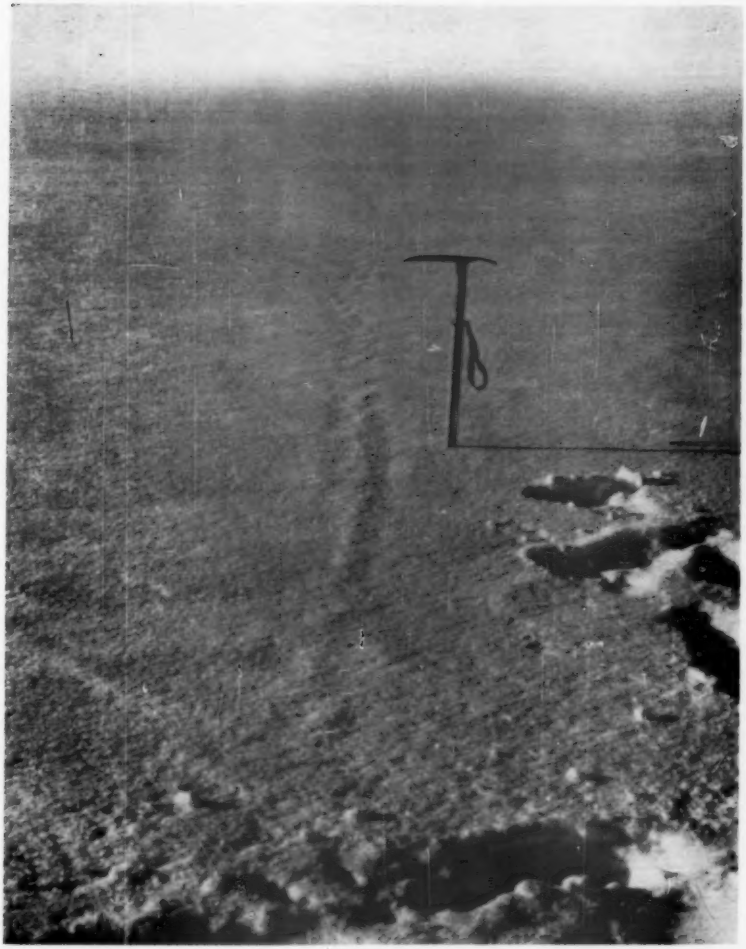

Figure 1. Tracks made by a walking penguin on the Filchner Ice Shelf. An ice axe is alongside for scale. (Photo by N. B. Augenbaugh.)

Figure 2. Tracks made by a tobogganing penguin on the polar plateau, Ellsworth Highland. The trough in the snow is made by the bird's belly. The sinusoidal parallel lines are made by the feet, which are alternately used to push the body forward. Faint marks made by the flippers are occasionally seen farther out to the side. An exposure meter is alongside for scale. (Photo by N. A. Ostenso.)

between pushes with the same foot was from 41 to 51 cm. Two deposits of excreta were seen about 800 meters apart (Hale and Murray, 1958).

These careful notes with photographs (Figure 2) were brought back by the traverse party. Samples of the excreta were collected in a sterile container and kept frozen until received at The Johns Hopkins University in October 1959. No microorganisms could be grown from the excreta in spite of careful culturing on a variety of enriched and selective media. The excreta were bright green, which demonstrated the penguin had been fasting for at least three days.

The track was too small to have been made by an Emperor Penguin, so it must have been one of the Pygoscelid penguins. The Adelie Penguin is by far the most likely, because of its circumpolar distribution on the Antarctic continent, although the possibility of a Chinstrap Penguin, *Pygoscelis antarctica,* cannot be excluded. These species are about half the standing height and roughly one-sixth the weight of the Emperor Penguin.

The penguin was traveling over 300 kilometers (186 miles) from the nearest known coastline of Pine Island Bay, and on an extraordinarily straight course that was taking it farther inland, roughly towards the South Pole. No species of penguin have yet been reported breeding along some 100° of longitude east between Ross Island in the Ross Sea and Alexander I Island in west Palmer Peninsula (Graham Land), except on Peter I Island. Here, less than 50 pairs of Adelie Penguins and one pair of Chinstrap Penguins were found nesting in 1948 (Holgersen, 1957). Since Peter I Island has such a small population of penguins and is about 1,000 kilometers (620 miles) away, it seems very likely that there are Adelie rookeries along the Walgreen and/or Eights Coast. It would not have been possible for such a small, flightless bird to have gained access to the polar plateau, and to have climbed to an elevation of 1,440 meters (4,720 feet), without an easy approach from the sea to the hinterland. This encourages us to believe that there is a suitable place where an exploration party could reach the plateau from this unknown coast. Also it seems reasonable to expect that the coastline is farther south than mapped and that the penguin had indeed walked less than 300 kilometers (186 miles).

Such a conclusion is substantiated in part by geophysical studies conducted in Marie Byrd Land (Ostenso, *et al.,* 1960; and Bentley, *et al.,* 1960), which show that a deep, subglacial trough extends between the Ross and Bellingshausen seas. Seismic soundings showed the ice to be 3,330 ± 20 meters (10,900 feet) thick beneath the point at which the penguin track was observed. Thus, the rock surface is 1,890 meters (6,200 feet) below sea level. The existence of this trough plus the

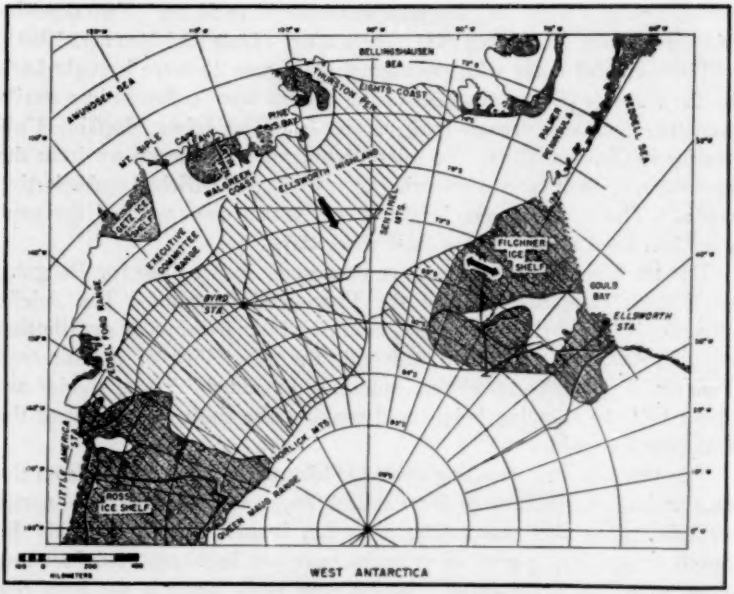

Figure 3. Map showing where the Byrd Station Traverse, 1957–1958, and the Ellsworth Station Traverse, 1957–1958, crossed penguin tracks whose location and direction are shown by the arrows. The Walgreen and Eights coasts are known only from aerial reconnaissance. The front of the Filchner Ice Shelf has been plotted by ship. Hachured area represents land surface below sea level. Dotted lines represent oversnow traverses 1957–1959.

extrapolation of the observed ice-surface slope northward suggests that the Eights Coast is considerably farther south than indicated on current maps. In addition, a reconnaissance flight in 1958 over the Walgreen Coast, on which one of the authors (N.A.O.) participated, showed this coastline to be considerably farther south than mapped. However, there was no marked East-West displacement of the coastal features. Thus, an extrapolation of the bird's course would indicate that it originated in Pine Island Bay. Radar altimeter soundings and surface features indicate that the Getz Ice Shelf is much larger than shown, particularly in eastern extent, being continuous with adjacent, unnamed bays. Therefore, Mt. Siple, Cape Leahy, and Martin Peninsula are probably islands. Another reconnaissance flight in January 1960 to the western edge of the Eights Coast indicated that the Thurston Peninsula is actually an island (Thiel, 1960).

Why this bird and others reported by Wilson and Péwé were so far away from known coast is a mystery. Adelie Penguins may travel as many as 100 kilometers over fast sea ice to reach their breeding ground in early spring, and the males are then capable of going without food for at least six weeks during October and November (Sladen, 1958: 48, 52). But in January, all successful breeders are feeding their young and spend most of their time at sea collecting food. There is, however, a shifting population of unsuccessful breeders and nonbreeders that return from sea at the end of the season either to occupy vacant nest sites or wander far away from the rookeries. These wanderers are probably mostly young nonbreeders. It has been suggested (Sladen, 1953) that under favorable conditions they will establish themselves in new areas, and thus extend the range of the species. This bird might have been one such nonbreeding wanderer that had lost its way.

The Byrd Station traverse party had the following members: V. H. Anderson, C. R. Bentley (Leader), D. P. Hale, J. B. Long, W. E. Long and N. A. Ostenso. All shared in collecting this record.

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GENERAL NOTES

Violet-crowned Hummingbird Nesting in Arizona and New Mexico.—In late July 1957, Levy (Auk, 75: 350, 1958) discovered six Violet-crowned Hummingbirds *(Amazilia verticalis)* in Guadalupe Cañon in extreme southeastern Arizona and southwestern New Mexico. These observations, plus those reported by Brandt (Arizona and Its Bird Life, p. 706, 1951), indicated that the species probably bred there. Working in this cañon during the summer of 1959, we recorded the nesting of this hummingbird in both states.

On 20 June Zimmerman saw a Violet-crowned Hummingbird add material to a barely begun nest 30 feet above ground in a sycamore *(Platanus wrightii)*, four tenths of a mile from the New Mexico boundary in the Arizona portion of Guadalupe Cañon. On the same day he saw another individual one mile from the state line in New Mexico. On 28 June we jointly visited the Arizona site but found no trace of the nest. In the same thicket, however, a Violet-crown, which we had under observation, flew to and settled on a completed nest near the tip of a horizontal sycamore branch at least 40 feet above ground. The bird appeared to be incubating, but we could not determine the nest contents. This hummingbird was also observed on the nest by Marian Zimmerman, Mr. and Mrs. Arnold Small, and Ben King, Jr.

On 29 June Levy several times observed a Violet-crowned Hummingbird carrying lichens and spiders' webs into a large sycamore one-half mile from the Mexican border in Arizona, but he did not find the nest.

Returning to the New Mexican section of the cañon on 5 July, Zimmerman found a Violet-crown's nest 1.3 miles from the Arizona boundary. It was saddled on a horizontal sycamore branch, about five feet from the tip and an estimated 25 feet from the trunk. Although only 34 feet above the trail, it could not be obtained or closely examined without risking destruction of its contents. Zimmerman watched this nest for several hours, during which time an adult remained on the nest for periods of up to 55 minutes, occasionally flying out to feed among nearby flowers or to chase foraging Gila Woodpeckers *(Centurus uropygialis)* from the branches about the nest. The bird assumed an elevated position on its nest, suggesting that it was brooding. Twice Zimmerman caught glimpses of what appeared to be the bill of a young hummingbird projecting above the nest rim when the adult was absent, although he noticed no behavior that could be interpreted as feeding when the adult returned.

On the same day Bruce Harris, Merle Wisnowski, and Zimmerman saw another Violet-crowned Hummingbird adding lichens to a nearly completed nest one mile from the Arizona state line in New Mexico. This nest, also in a sycamore, was placed in the sharp angle of a "V" in a malformed, semipendant branch about 25 feet above ground. The attending bird proved to be a female with enlarged ova and a distinct brood patch. This specimen apparently is the first Violet-crowned Hummingbird taken in New Mexico.

At a third New Mexican locality, 1.6 miles from the Arizona border, the Zimmermans repeatedly saw two Violet-crowns, one or both of which made nine observed trips to the same portion of a particular sycamore, and remained hidden there for long periods of time. Careful scrutiny of the branches disclosed no nest, but one individual of this presumed pair was seen to gather insects from spiders' webs and tree trunks and fly directly to the sycamore tree.

Dr. Alexander Wetmore has very kindly identified the New Mexican Violet-crowned Hummingbird specimen, and that collected by Levy in Arizona in 1957,

as *Amazilia verticalis ellioti*, a form heretofore considered accidental in the United States.—DALE A. ZIMMERMAN, *Department of Biology, New Mexico Western College, Silver City, New Mexico*, and SEYMOUR H. LEVY, *Route 9, Box 960, Tucson, Arizona.*

A Skeltal Teratism in Neonatal Red-winged Blackbirds.—Two similar teratological specimens of the Red-winged Blackbird, *Agelaius phoeniceus*, from different geographical areas were found in the course of artificially incubating eggs of this species. The defect was observable in the neonates only by corrosion-staining-clearing techniques; therefore the ultimate fates of individuals so affected in life is unknown as is also the incidence of occurrence. The defect was not observed in any of more than 500 specimens of about 100 species of passerines similarly (mostly concurrently) incubated, hatched, and prepared (Wetherbee, Artificial Incubation of Wild Birds' Eggs and Developmental Condition of Neonates, pp. 1–153, University Microfilms, 1959). The first of these specimens was taken at Storrs, Connecticut, the second at New Salem, Massachusetts.

Figure 1. Skeltal teratism (upper) in neonatal Red-winged Blackbird.

Following is a description of the anomalous condition (Figure 1, upper) compared with the normal (Figure 1, lower). The femora and humeri were crooked (the most striking character); the ilia and ischia were much shortened; there was delayed ossification at the distal ends of tibiae, tarsometatarsi, ulnae, and radii. Dr. Walter Landauer (University of Connecticut, 14 April 1958, personal communication) did not remember having seen a similar condition in his extensive experience with teratological embryos of fowl. That there seems to be an over-all retardation in ossification could suggest that the abnormal birds, although neonatal, are merely physiologically younger than the normal neonates. However, the

absence of significant intraspecific variation in ossification in just-hatched young of other passerines (Wetherbee, Comparative Phylembryogenetic Dimensionality of Neonatal Birds, pp. 1–260, University Microfilms, 1958) and the decided crook observed in the femur and humerus argue against causation by premature hatching.

It is almost impossible from such isolated cases to speculate about the mechanism(s) of origin. However, it seems appropriate to record that the first specimen came from a population sympatric with a population of Common Grackles, *Quiscalus quiscula* (probably exposed to intensive agricultural chemical applications), from which a microphthalmic individual was described (Wetherbee, Auk, 75: 101–103, 1958). The second specimen was the only bird hatched in a breeding wild colony of blackbirds experimentally exposed to tetramethyl thiuram disulfide (thiram).

If this teratological condition described in the Red-winged Blackbird is either a sporadically occurring, natural genetic expression or an exogenously, chemically induced one, the condition has potential significance in the population dynamics of the species.—David Kenneth Wetherbee, *Department of Poultry Science and Massachusetts Cooperative Wildlife Research Unit supported by the University of Massachusetts, the U. S. Fish and Wildlife Service, the Massachusetts Division of Fisheries and Game and the Wildlife Management Institute, Amherst, Massachusetts.*

Red-eyed Cowbird Parasitizes Song Sparrow and Mexican Cacique.—The Red-eyed Cowbird *(Tangavius aeneus)*, previously unrecorded as a breeding bird from the Valley of Mexico (Miller *et al.*, Pac. Coast Avifauna, 33, 1957), is a frequent parasite of Song Sparrows *(Melospiza melodia)* in Chapultepec Park, in the heart of Mexico City. This is the first record of the Song Sparrow as a host of this cowbird species.

The nesting area studied (the southern half of the horticultural gardens) covered approximately an average city block. Within this area I found seven active or abandoned Song Sparrow nests in August 1956; six in June 1957; and six or seven in April 1958. Not all of these could be examined, so the proportion of active to abandoned nests could not be accurately determined; however, these numbers indicate a high and concentrated local breeding population of Song Sparrows. I believe no other area in the park contained such a concentration of sparrows or any other suitable host for the Red-eyed Cowbird. In the gardens the vegetation is rigorously clipped and all lower branches removed, thus forcing the sparrows to nest higher than normal. Nests were found from two to 10 feet above the ground. The presence of a population of rats (cf. *Rattus norvegicus*) probably also has an effect on the choice of nesting site. The nests are less well concealed than in more natural areas.

Thirteen Song Sparrow nests examined from the park contained 14 eggs and six nestlings of the sparrow, and 13 eggs and two juveniles of the parasite. Three active nests with two or three sparrow eggs each contained also a single cowbird egg. Two nests contained a single sparrow egg and a juvenile cowbird. A cowbird egg in an active nest with two Song Sparrow eggs was slightly more advanced in development than were those of the sparrow.

Song Sparrows in Chapultepec Park apparently will abandon a nest when two or more Red-eyed Cowbird eggs are deposited in it. Six of the 13 sparrow nests examined had been abandoned; five of these contained one to three cowbird eggs. One of the two nests with three cowbird eggs also contained two sparrow eggs; the other contained none of the host species. In the latter nest the cowbird eggs

varied so much in both size and degree of freshness as to indicate that they were probably laid by different females over a considerable period of time. The three in the other nest did not vary greatly and might have been laid by a single bird.

The Brown-headed Cowbird *(Molothrus ater)* has been recorded laying eggs in a nest prior to laying by the host species (Bent, Bull. U.S. Nat. Mus., 1958), but this does not seem to have been reported for the Red-eyed Cowbird. The largest number of eggs found in a single nest was three (Friedmann, The Cowbirds, 1929). Near a greenhouse in the horticultural garden on 2 July, I found five eggs of the Red-eyed Cowbird in a weathered, nearly flat nest (probably *Pipilo fuscus*). Two of these were broken, two were bleached white, while the fifth was spoiled, but still retained the bluish cast present in newly laid eggs. This obviously long-abandoned nest probably acted as a dump nest, such as is well known in pheasants and some ducks.

The Red-eyed Cowbirds in the Chapultepec Park population begin laying by at least early April. An egg taken from a Song Sparrow nest 8 April contained an embryo approximately half developed, and fresh eggs were found as late as 2 July. Sixteen eggs collected in the park measure 17.2 to 18.4 (av. 17.78) by 21.6 to 24.4 mm. (av. 22.91).

A second species previously unreported as a host for the Red-eyed Cowbird is the Mexican Cacique *(Cassiculus melanicterus)*. On 13 July 1956 John and Richard Campbell and I collected a nest about five miles southwest of Navarrete, Nayarit. The nest contained three eggs of the cacique and one of the Red-eyed Cowbird. Dr. Friedmann *(in litt.)* informed me that Dr. Travis Meitzen collected a nest of the Mexican Cacique at Tehuantepec, Oaxaca, 11 June 1945 that contained four eggs of the host and one of the Red-eyed Cowbird. The use of the deep nests of the caciques by the cowbirds as a place to deposit their eggs is an interesting extension of their well-known preference for other species of orioles of the genus *Icterus*.—Robert W. Dickerman, *University of Minnesota, Museum of Natural History, Minneapolis, Minnesota.*

The Black Noddy at Los Roques, Venezuela.—In the spring of 1862 the renowned British ornithologist Osbert Salvin (1864) discovered a colony of Black Noddies *(Anoüs tenuirostris)* on a little islet off British Honduras known as Southwest-of-all Cay, and collected there a series of skins and eggs for the British Museum. These specimens formed the basis of a new subspecies, *A. t. americanus*, described by Mathews (1912) as *"Megalopterus minutus americanus."* There was no further information on the Caribbean race of the Black Noddy until an individual was caught and photographed in mangroves at Bonaire in 1952 and recorded by Voous (1957). In 1956 and 1957 specimens were collected on Los Roques (Bequevé, Los Canquises, and Sarquí) in late May and early July, and it was presumed by Phelps and Phelps (1959) that the species was breeding there at the time.

On 26 and 27 March 1960 we had the privilege of going ashore on two islets, Esparquí and Carenero, of the Los Roques archipelago in company with Dr. William H. Phelps and Mr. William H. Phelps, Jr., while aboard their yacht "Ornis." We soon noticed that the Noddy terns flying overhead or perching in the mangroves that densely cover these sandy cays uttered two very different calls, and it was apparent that two species were present. In addition to the hoarse, rooklike growling of the Brown Noddy *(A. stolidus)* was heard the high-pitched, rattling *tek-kerrek* of the Black Noddy.

We watched numerous Black Noddies dipping into the sea or along the edge of the tide, picking up pieces of sea wrack, weed, fragments, or vegetable material. The nests were situated for the most part higher than those of *stolidus* and are recognizably different. Whereas the Brown Noddy on Los Roques makes a bulky nest composed mainly of twigs well out on the surface of a branch, that of the Black Noddy is a comparatively compact pad of vegetable material in a crotch. It commences by being neat, clean, and rather brightly ornamented with colored streamers of weed, but soon becomes matted, dull, and splattered with droppings. Nests of the two species were often in the same tree. Betts (1940) describes the nest of *Anoüs tenuirostris tenuirostris* in the Seychelles Islands as being very similar, composed of a pad of seaweed, lodged high up in forks of branches of banyan trees. The nesting material is picked up at high-water mark by the birds just as we saw it done in the southern Caribbean.

Both Noddies were beginning to breed at this season, but of the many nests examined, only two of each species contained an egg. Two eggs of the Black Noddy, both fresh, were collected, and adults were secured at or near the nests. The eggs resemble, but are much smaller than, those of the Brown Noddy. One (YPM coll.) measures 40 x 30 mm., the second (Phelps coll.) 43 x 27 mm. We have no doubt that an egg found "on the bare rock on El Soldado" off Trinidad, and believed by Belcher and Smooker (1935) to be that of a Black Noddy, pertains to *stolidus*. This egg measures "50 x 34 mm.," and lies within the size range of eggs of the Brown Noddy, which average 52 x 35 mm., according to Bent (1921).

We are in agreement with Dr. Robert Cushman Murphy of the American Museum of Natural History, who informs us *(in litt.)* that in his opinion "the two large noddies all over the world, namely the Brown and the Black, each represent one species."

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—James Bond and S. Dillon Ripley, *Academy of Natural Sciences, Philadelphia, Pennsylvania,* and *Peabody Museum, Yale University, New Haven, Connecticut.*

Eighteenth-Century Observation of Flight of Passenger (?) Pigeons over New York City.—Hugh Gaine, an Irish-born printer and bookseller, who landed in New York in 1745 "without basket or burden," ran a print shop across from the Old-Slip Market and established the "New-York Mercury." On Monday, 11 March 1754, on page 3, he recorded: "Yesterday we had the greatest Flight of

Pidgeons over this City, that has been known for many Years past, so early in the Season."—CONSTANCE D. SHERMAN, *American Museum of Natural History, New York City.*

Cattle Egrets on the Dry Tortugas.—The first known observation of Cattle Egrets *(Bulbulcus ibis)* on the Dry Tortugas, Florida was 1 January 1958. The Cattle Egret was again observed on 7 and 8 May 1960. On 7 May nine individuals were counted on Garden Key, and on 8 May 19 were seen. Since the island is only about one third by one sixth of a mile in size and sparsely vegetated, an exact count was easily possible. The Cattle Egret does not appear in Sprunt's (1951) "A List of the Birds of the Dry Tortugas Keys."

A cold front traveling east passed the Tortugas at about 1:00 A.M. on 8 May. The southerly winds favorable to northbound migrants that prevailed during the previous day were replaced by northwest winds. In addition, electrical storms and heavy precipitation appeared. A large number of migrants appeared on Garden Key, and the number of species seen rose from 33 on 7 May to 77 on 8 May. Perhaps it is also worthy of note that although no Green Herons were seen on 7 May, about 10 were present on 8 May. This information is mentioned to demonstrate that the birds appearing 8 May were evidently part of a migratory wave that had departed from Cuba, the Yucatan Peninsula, or some other southern point during a period of favorable weather. Since it seems unlikely that the additional 10 birds on 8 May would have come from the mainland to the north or from the Florida Keys (Key West is about 68 miles to the east), one is forced to conclude that they were northbound migrants forced down on the Dry Tortugas along with the other migrant species.

These observations suggest a hypothetical route by which the Cattle Egret may have invaded the United States and provide strongly suggestive information in regard to the migratory activity of the species. Although it is well established that the species withdraws in autumn from breeding areas in the northern states and that the majority appear to winter in Florida, it has not been determined whether the Florida breeding population is migratory or sedentary. The season of these observations is certainly not typical of the postbreeding wandering of the herons. Therefore, we must ask whether this represents merely haphazard wandering or part of an annual migratory pattern.—IRA JOEL ABRAMSON, *1070 South Shore Drive, Miami Beach, Florida.*

Clay-colored Robin in Texas.—In May 1959 a Clay-colored Robin *(Turdus grayi)* was reported in Bentsen State Park three miles west and three miles south of Mission, Texas. The bird was first seen on 14 May by Mrs. L. H. McConnell, wife of the park manager. During the following week it was observed by a number of ornithologists both from the lower Rio Grande Delta and from out of state. Among the observers were Luther Goldman, U.S. Fish and Wildlife Service, Washington, D.C., and Alexander Sprunt IV of Charleston, South Carolina.

Bentsen State Park is about 600 acres in extent and lies just west of a large bend of the Rio Grande. The vegetation is typical of the "river brush" of this area—the more heavily wooded sections being composed of large ebony *(Pithecolobium flexicaule)*, mesquite *(Prosopis)*, native ash *(Fraxinus berlandierana)*, elm *(Ulmus crassifolia)*, and anaqua *(Ehretia anacua)*, mixed in with the usual catclaw *(Acacia greggii)*, huisache *(Acacia farnesiana)*, granjeno *(Celtis pallida)*, brasil *(Condalia obovata)*, allthorn *(Koberlinia spinosa)*, and other small shrubs.

Openings are normally covered with a luxuriant growth of weeds and various other annuals, many of which reach a height of seven to eight feet.

The Clay-colored Robin was most frequently seen in or near a section of ebony trees where there was dense undergrowth of small shrubs and large weeds. It was in a rather low-lying area near a shallow stream bed, in a habitat almost identical to ones in which I have frequently seen the bird in Mexico.

It apparently remained in the park for at least three weeks, being last reported by Mrs. McConnell about 8 June. During this time it was observed by a number of visiting ornithologists and was photographed by P. B. Myers of McAllen, Texas. A kodachrome slide of the bird provided by Mr. Myers has been sent to Dr. George H. Lowery and is now on file at the Louisiana State University Museum.

The only previous record of the Clay-colored Robin in Texas appears to be a sight record published by L. Irby Davis in "Bird Lore," vol. 42 (3), May–June Supplement, 1940, although there has been at least one unconfirmed and unpublished report of the bird in the same area within the last few years.—PAULINE JAMES, *Associate Professor of Biology, Pan American College, Edinburg, Texas.*

Canada Geese Nesting on a Beaver Lodge.—The benefit of a beaver *(Castor canadensis)* pond for nesting and migrating waterfowl has been reported in the literature and is generally accepted by most investigators. Muskrat *(Ondatra zibethica)* lodges have been reported by Williams and Nelson (Auk, 60: 341–345, 1943) as being influential ecological factors and add considerably to the nesting value for Canada Geese *(Branta canadensis)* of certain emergent environments, notably cattail *(Typha latifolia)* and alkali bulrush *(Scirpus* spp.). Beaver lodges may have a similar influence on the nesting value of certain areas for Canada geese.

On 23 April 1960 the author observed an unusual commensal interaction between a beaver colony and a pair of Canada Geese. A nest containing three eggs was observed on top of an active beaver lodge in the Conneaut marsh located in Crawford County, Pennsylvania.

On 28 May 1960 it was observed that the clutch was successful, and that the beavers had not interfered with incubation. The beaver colony and the Canada Geese shared the same lodge with no serious consequences resulting to either.—FRED J. BRENNER, *Department of Zoology and Entomology, Pennsylvania State University, University Park, Pennsylvania.*

Great Black-backed Gulls Killing Dovekies.—On 16 November 1959 there was a Dovekie "wreck" on Cape Cod, which centered at Bodfish Park, East Sandwich, at the head of Cape Cod Bay. During the second day of a northeast gale observers there watched for two and a half hours as an estimated thousand Dovekies *(Plautus alle alle)* were driven ashore by a 50-mile-an-hour wind, which was directly onshore. The dramatic scene was described to me by the marine biologist, Colonel E.S. Clark, with whose permission I am recording the following details.

Flocks averaging about 25 Dovekies each were blown in, one after another, and, attempting to land on the six-foot waves crashing on the shore, were hurled to the beach. Here, on the sand or in small pools, they were pounced upon by the Great Black-backed Gulls *(Larus marinus)* hovering over the area. Picked up in a gull's bill, the Dovekie was carried high over the parking area and dropped directly on the black-top surface. The gull followed it down, tore it apart, and swallowed the pieces. If the Dovekie was able to break its fall by spread wings, the gull picked

it up and dropped it a second time, which insured its death. There were often 20 Dovekies struggling at the water's edge at one time, with the gulls fighting to get at them. On about 10 occasions a gull was seen actually catching a Dovekie on the wing, "picking it out of the air." Each time it was caught by the back of the neck and brought down to the ground, shaken hard until it became limp, and then eaten. Of the thousand or more Dovekies blown ashore here, Dr. Clark believes that few if any survived, "they were no doubt eaten at once as gulls were in the air everywhere."

No specific instance of this species catching Dovekies has been found in literature or through correspondence. The dropping of clams and other molluscs on hard surfaces by various species of gulls is well known. But Tinbergen ("The Herring Gull's World," Collins, 1953, p. 31) says: "I know of only one instance in which a gull was seen dropping something soft" (a Great Black-backed Gull dropping a rat).

The general features of this Dovekie wreck in eastern Massachusetts were described by Snyder, 1960, Mass. Audubon, 44 (3): 117–121.—Dorothy E. Snyder, *Curator of Natural History, Peabody Museum, Salem, Massachusetts.*

Starlings Fed by Purple Martins.—Observations made of a martin house on 4 July 1959, at Otsego, Michigan, revealed an incidence of foster parental care of a brood of Starlings *(Sturnus vulgaris)* by a pair of Purple Martins *(Progne subis)*. Such behavior was not recorded in the studies of the Purple Martin by either Bent (1942, U.S. Nat. Mus. Bull. No. 179: 489–509) or Nice (1952, Am. Midland Nat., 47: 606–665).

Early in the afternoon a considerable commotion from within the compartment adjacent to the Starlings' attracted my attention, and close scrutiny with binoculars disclosed a female martin struggling with some unidentifiable object. Some time later, as the male martin approached the entrance of the compartment with food, it was greeted by the heads of two young Starlings, and a short time later the number had increased to three. About midafternoon a fourth Starling, apparently the smallest of the brood, was observed walking across the balcony from its compartment and entering the martins' compartment.

The male martin made at least 40 trips during the remaining part of the afternoon and readily presented the food it had collected to the young Starlings, making no attempt to enter the compartment other than to pick up fecal material dropped near the entrance. The female martin made less than half as many trips as the male and frequently attempted to force its way into the compartment but was usually unsuccessful as the Starlings blocked the entrance and met the bird's advances with open mouths. Once the female had gained entrance, it had great difficulty pushing its way back out past the young birds.

The feeding of the Starling brood was continued the following day. As it was necessary to leave the area and thus discontinue further observations, one of the young Starlings was collected and is now held by the Department of Zoology, Michigan State University.—Willet T. Van Velzen, *Department of Entomology, Michigan State University, East Lansing, Michigan.*

Foot-Quivering by Foraging Hermit Thrushes.—In his discussion of "hostile" behavior by Hylocichlid thrushes (Auk, 73: 313–353, 1956), Dilger interprets the foot-quivering that is done by some of these birds as a display indicating a very low general motivation of the attack and escape drives in balance (p. 331) and states (p. 332) that he has never seen it done by a foraging bird.

Eight out of nine Hermit Thrushes *(Hylocichla guttata)* that I have watched closely as they foraged on lawns have done foot-quivering, sometimes so vigorously that the whole body shook. Some of them have done it at practically every pause during as much as seven and eight minutes on the lawn, some others only occasionally. On a few occasions I have been able to see that the raised, quivering foot was patting only the tops of the grass blades; at other times the ground has clearly been patted.

A bird on a lawn in a wooded section of Baltimore city, 16 October 1953, was the first that I noticed doing foot-quivering. On 20 April 1956, on my lawn at the edge of a wood in Larchmont, Baltimore County, another did it; during that feeding period I banded the bird; six more times, then, through 25 April, I saw it forage on the lawn, and each time it did foot-quivering. On 23 and 25 April an unbanded Hermit Thrush fed on the lawn simultaneously with, but many yards away from, the banded bird, and both times did foot-quivering. On 30 April and 1 May a Hermit Thrush there did it three of seven times that it was seen; the last two times it performed it was identifiable by color bands as the same individual. One on my lawn 11 October 1956, did it on both of two occasions that it was watched; one there 15 April 1957, did not; one 12 October 1957, did it on two occasions that it was watched, and two birds on 13 October did it during four out of six observations.

An observation just published by Skutch ("Life Histories of Central American Birds," II: 101, 1960) on the Russet Nightingale-Thrush *(Catharus occidentalis)* appears to be another instance of foot-quivering during foraging. Of a bird he watched in a Guatemalan cloud forest as it ate the berries of a trailing vine, he says: "At intervals the bird was seized with a fit of trembling, and the tail, feet, and whole body quivered as though it suffered from the cold." *Catharus* is the genus to which Dilger (op. cit.) proposed that the Hermit Thrush be transferred. —Hervey Brackbill, *2620 Poplar Drive, Baltimore 7, Maryland.*

REVIEWS

Check-list of the Birds of the World.—A continuation of the work of James L. Peters—IX, edited by Ernst Mayr and James C. Greenway, 1960. Mus. Comp. Zool., Cambridge, Mass. 506 pp. $7.50.—The new volume of Peters' Check-list has been greatly welcomed, as ornithologists had long waited for it. An inevitable delay was caused by the death in 1952 of the original author, and the new editors have had a great deal of work and difficulty to establish a new basis for its production. It was obvious from the beginning that no single ornithologist could have enough time to complete such a list, and Peters only lived to write seven of the fifteen planned volumes. The eighth volume has been written by J. T. Zimmer, who himself died before its full completion. The remaining volumes will be the work of various authors, all highly qualified for the parts they are dealing with. It is of course a very considerable advantage to have each family reviewed by the best technician available, but it also has the slight drawback of a certain unevenness as each part necessarily reflects the tendencies of each author, as some recognize more genera, species, and subspecies than others. Each part, however, has been read by highly competent ornithologists, while the task of the editors has been a heavy one. In order to preserve the unity and cohesion of the work, they undoubtedly must now and then propose alterations and suggest corrections that are not always gladly accepted by the authors. The present volumes include the Oscines belonging to the following families: Alaudidae and Hirundinidae, already prepared by Peters; Motacillidae, by Vaurie, White, Mayr, and Greenway; Campephagidae, by Peters, Mayr, and Deignan; Pycnonotidae, by Rand and Deignan; Irenidae, by Delacour; Laniidae (including Prionopinae) and Vangidae, by Rand; Bombicillidae (including Ptilogonatinae and Hypocoliinae), Dulidae, and Clinclidae, by Greenway; Troglodytidae, by Paynter and Vaurie; and Mimidae, by Davis and Miller.

There is very little to criticize in this volume, and it is certainly even more accurate than any of the preceding ones because of the special familiarity of the authors with the birds they have reviewed. Only very few and unimportant points require correction. I happened to notice, for example, that Cochinchina and Phuquoc Island are omitted in the distribution of *Hirundo tahitica abbotti* (p. 109), and that a misprint in my own chapter (p. 307) indicates in the distribution of *Irena puella puella*, southwestern and northwestern India, instead of southeastern and northeastern. There is also a mysterious footnote (1, p. 193) on the invalidity of *Coracina ostenta* Ripley, which is difficult to understand. But such small lapses are hardly worth mentioning. May I say that I am personally gratified to find that the various authors have accepted the systematic modifications brought up by me previously for a better grouping of species and subspecies, with, of course, some necessary alterations due to the results of later investigation. It is now expected that the rest of the volumes will appear in quick succession, although not necessarily in the order of their number. This most important work is urgently needed by all ornithologists, and they cannot wait much longer for its full completion. —J. Delacour.

Comparative Breeding Behavior of Four Species of North American Herons.—Andrew J. Meyerriecks. 1960. Publications of the Nuttall Ornithological Club, No. 2, Cambridge, Mass., 158 pp., 39 line drawings, 15 pls.—An advantage of herons for the comparative study of behavior is the great variation

in degree of gregariousness in different species. This well-illustrated booklet, based chiefly on observations in New York and Florida, is a precise and detailed account of the locomotory, feeding, alarm, and pairing behavior of the Green Heron, Great Blue and Great White Herons (treated as conspecific), Reddish Egret, and Snowy Egret. A brief (22 pp.) section on evolutionary trends in heron behavior, together with a summary chart, concludes the presentation.

Throughout, the Green Heron, *Butorides virescens*, is used as the main basis for comparison. During three seasons on a small island in Jamaica Bay, Long Island, the author made many significant observations on pair formation in this relatively solitary species. He brings out very well the gradual increase in tolerance and decrease in hostility between male and female as pair formation progresses. Outstanding in the accounts of other species of heron are the spectacular courtship displays of the Reddish Egret and of the Snowy Egret, as well as the description of the nature and evolution of canopy feeding in the Reddish Egret. Comparisons of the behavior of different species of herons are for the most part scattered throughout the text. In general, the smaller species are more active and have more diversified feeding behavior and displays, *e.g.*, special aerial displays, compared with the relatively sluggish larger herons. Meyerriecks indicates two types of pair formation. In the less gregarious species like the Green Heron, a stationary male displays and a mobile female roams from one male to another. In the more sociable species like the Snowy Egret, a rather mobile male displays and a number of conspecific individuals then gather about him, the whole party moving from place to place.

This work provides a solid basis for further study by use of marked individuals, the experimental method, and extension to other species, particularly to the bitterns. In general, the style is clear and logical, the book is well organized, and there are few difficulties to the reader. However, the author objects to pigeonholing displays as sexual or hostile, and then proceeds to classify certain displays, which he considers as primarily sexual, under the rubric "Hostile Behavior." The final discussion is too brief to do justice to the text in giving a comparative picture of the sexual and aggressive displays of the various species. The "Comparative Behavior Chart" at the end of the book summarizes in conservative fashion the distribution of some 60 specific behavior patterns among 10 species of North American herons (excluding bitterns). In almost every instance this table shows that a certain display is either present in a given species or else information is deemed inadequate to judge. One wonders if a table with such a dichotomy and so full of question marks is really an important gauge of our ignorance, or merely shows anew the difficulty of proving a negative in any absolute sense.

The close observation and detailed descriptions of the author are a fine contribution to our knowledge of the behavior of North American birds.—NICHOLAS E. COLLIAS.

Proceedings of the First Pan-African Ornithological Congress.—Ostrich, Supplement No. 3, 1959. x + 445 pp. Paper, 25 shillings.—Those fortunate enough to attend the Ornithological Congress at Victoria Falls, Rhodesia in 1957 will always treasure the memory of this occasion, especially against the recent somber turn of events in that continent. The 55 papers presented are here published in a well-produced and illustrated volume. Some of the contributions are rather sketchy, but others are extremely detailed and valuable, *e.g.*, Broekuysen's "Life History of the Curious Cape Sugarbird, *Promerops cafer*."—D. AMADON.

The Galápagos Islands, A History of Their Exploration.—Joseph Richard Slevin. 1959. Occasional Papers of the California Academy of Sciences, No. 25. x + 150 pp.—The Galápagos Islands, a volcanic archipelago of 15 islands, and numerous islets and rocks, are distinguished by the attention that they have attracted from a galaxy of scientific talent. Primarily this interesting publication is an account of the exploration of these islands beginning with the visit of Fray Tomás de Berlanga in 1535. It thus serves as a most useful complement to the many scientific papers that have resulted from investigations on these islands. Major attention is given to the visits of the *Rattler* (1793–1794), *Essex* (1813–1814), *Beagle* (1835), *Le Genie* (1846), and the *Decres*. There is also a brief account of the expeditions to the Galápagos. This emphasizes the role of the islands as a source of materials for the study of zoogeography and organic evolution.—D. S. Farner.

Fauna of the Aleutian Islands and Alaska Peninsula with Notes on Invertebrates and Fishes Collected in the Aleutians 1936-38.—Olaus J. Murie and Victor B. Scheffer. 1959. North American Fauna No. 61. 406 pp. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. $1.25.—This number of the North American Fauna series is based primarily on a biological survey made during 1936 and 1937. The first part (pp. 1–364), prepared by Olaus J. Murie, consists of a general description of the area (pp. 1–26), an annotated list of birds (pp. 27–261), and an annotated list of mammals (pp. 262–339); the second (pp. 365–405), prepared by Victor B. Scheffer, is concerned with collections of invertebrates and fishes collected in conjunction with the biological survey. The annotated list of birds contains 204 species.—D. S. Farner.

Life Histories of Central American Birds II.—Alexander F. Skutch. 1960. Cooper Ornithological Society. Pacific Coast Avifauna, 34: 593 pp., 100 figs., 1 col. pl.—The reputation of A. F. Skutch will be further enhanced by the second volume of his life history studies. The observations were made at several spots in Central America but principally in Costa Rica and Panama between 1929 and 1956. This volume includes rather fragmentary information on some scarce species whose life histories Skutch does not expect to complete. Only a summary is given for about eight species, whose life histories were published in detail in journals. The accounts include life histories of 3 vireos, 2 gnat-catchers, 5 thrushes, 12 wrens, 1 bush-tit, 2 jays, 3 swallows, and 31 flycatchers. A notable part is the general summary for each family giving comparisons. Where possible, information on range, food, voice, behavior, nest building, eggs, incubation, and nestlings is given. For many species a summary is available. A most commendable effort has been made to include quantitative data on clutch size and nesting dates.

Comparisons with my own notes for birds in Panama and British Guiana show no discrepancies. Skutch has clearly assembled over the years an authoritative description of the life histories of these species. The modernity of the concepts underlying the exposition of data is refreshing.—David E. Davis.

On the Birds of Afghanistan.—Knud Paludan. 1959. The 3rd Danish Expedition to Central Asia, Zoological Results 25. Reprinted from Videnskabelige Meddelelser fra Dansk Naturhistorik Forening i København, 122. 332 pp. Bianco Lunos Bogtrykkeri A/S, Copenhagen. 35 Danish kroner.—The author studied and collected birds in Afghanistan from 13 December 1947 through 14 November 1948. A section of 38 pages is concerned with the physiography, ecologic distribu-

tion of birds, and migration. Most of the remainder of the book consists of an annotated list of 387 species, based primarily on the author's observations and collections but also with some reference to previously published information. This is an important contribution to the ornithology of an area whose avifauna is still imperfectly known. The author states that he collected and fixed the gonads, adrenals, thyroids, and hypophyses of large numbers of individual birds and that these are available for study to serious investigators as a supplement to current research. Application can be made to the Institut for Sammenlignende Anatomi, Universitetsparken 3, Copenhagen Ø.—D. S. FARNER.

The Birds of Heard Island.—M. C. Downes, E. H. M. Ealey, A. M. Gwynn, and P. S. Young. 1959. Australian National Antarctic Research Expeditions Reports, Series B, Vol. 1. 135 pp. Librarian, Antarctic Division, Department of External Affairs, 187 Collins Street, Melbourne, C. 1., Victoria, Australia.—This report summarizes primarily the ornithological observations made during the period 1948–1954. The extensively annotated list includes 28 species. Of particular interest and value are the treatises of the King Penguin, *Aptenodytes patagonica;* Gentoo Penguin, *Pygoscelis papua;* Macaroni Penguin, *Eudyptes chrysolophus;* Black-browed Albatross, *Diomedea melanophris;* Giant Petrel, *Macronectes giganteus;* and Fulmar Prion, *Pachyptila crassirostris.* This is a significant contribution to Antarctic ornithology.—D. S. FARNER.

Birds of Anaktuvuk Pass, Kobuk, and Old Crow. A Study in Arctic Adaptation.—Laurence Irving. 1960. United States Museum Bulletin 217. 409 pp. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. $2.00.—This is a commendable synthesis of the natural history, ecology, and certain aspects of the physiology of arctic Alaskan birds. Individual chapters contain extensively annotated lists of the birds of Old Crow, Anaktuvuk Pass, and Kobuk. A further chapter compares the avifaunae of these three localities, and is an important contribution to our knowledge of the distribution of birds in arctic Alaska. A chapter on migration discusses routes, breeding and wintering ranges, and relationships to climate. Considerable attention is given to the correlation of migration and reproduction with the arctic summer. There is an interesting discussion of the use of fat as a source of energy, the usefulness of which could have been enhanced somewhat by a more extensive use of the rapidly expanding literature on fat as a readily mobilizable energy reserve. Perhaps the most significant and important chapter is the last, "Arctic Metabolic Economy of Warm-blooded Animals." It clearly defines the metabolic problems of arctic birds and mammals and the adaptations that they have developed. It concerns a field in which the author and his colleagues have made most significant research contributions. It is a chapter that can be read with profit by all ornithologists.—D. S. FARNER.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

Anatomy and Embryology

Berger, A. J. 1960. Some anatomical characters of the Cuculidae and the Musophagidae. Wilson Bull., **72**: 60–104.—The musculature of *Tauraco leucotis donaldsoni*, a musophagid, is described. Pterylography, skeleton, and musculature are compared within the Cuculidae and between the two families. Implications of anatomy for the classification of cuckoos are discussed. The Musophagidae deserve ordinal rank.—J. T. T.

Hudson, G. E., P. J. Lanzillotti, and G. D. Edwards. 1959. Muscles of the pelvic limbs in Galliform birds. Amer. Midl. Nat., **61**: 1–87.

Sigmund, L. 1959. Mechanik und anatomische Grundlagen der Fortbewegung bei Wasserralle (*Rallus aquaticus* L.), Teichhuhn (*Gallinula chloropus* L.) und Blasshuhn (*Fulica atra* L.). Jour. für Ornith., **100**: 3–24.—The mechanical and anatomical bases for locomotion (walking and swimming) in a rail, gallinule, and coot. In addition to anatomical data, a series of pleasing diagrams of the progression of these birds, based on motion pictures, characterizes the varying appearance in movement of the three genera, and will interest ethologists, bird artists, and field students, as well as anatomists and physiologists.—E. E.

Behavior

Betts, M. M. 1958. The behaviour of adult tits toward other birds and mammals near the nest. Brit. Birds, **51**: 426–429.

Crook, J. H. 1960. Nest form and construction in certain west African Weaver-birds. Ibis, **102**: 1–25.—The basic construction of a weaver-bird nest is described, beginning with the initial ring and proceeding to shaping and stitching. Several types of these nests are described, including globular, kidney shaped, incomplete kidney shaped, and retort shaped. Detailed description of nest construction is given for *Quelea quelea* and compared with that of other species. Methods of attachment, size of bird, and construction from a fixed point inside the ring are factors determining nest form. Length of funnel is correlated with time spent building and duration of breeding season. In evolution of nest forms there is a correlation between long breeding seasons, insect diet, nesting in trees, and tubular entrances. Short breeding seasons and globular or kidney-shaped nests are also correlated. Individual and local variation in nest form indicates direct adaptation to special circumstances and nest sites available. Breeding behavior is discussed. Construction of a properly built nest requires constant repetition of building sequences and sustained building. Low motivation results in irregular positions and shapes.—J. W. H.

Hailman, J. P. 1960. Direct and indirect scratching by a fledged Mockingbird *Mimus polyglottos*. Ibis, **102**: 129–131.—Besides a description of both types of scratching in Mockingbirds, there is a list of scratching methods observed in 13 nonpasserines and 26 passerines. It is suggested that age of bird and circumstances of the observation should be noted in future recording of birds seen scratching.—J. W. H.

Hickling, R. A. O. 1959. The burrow-excavation phase in the breeding cycle of the Sand Martin *Riparia riparia*. Ibis, **101**: 497–500.—Sand Martins arrive at

the breeding place unpaired and in a stage of low social organization. Group display with mounting excitement and mutual stimulation is climaxed by communal digging of burrows (approximately one burrow per individual), then building and laying. The display period sexually synchronizes the entire colony, seemingly a necessity for the continued communal behavior of its members.—J. W. H.

HOFFMANN, K. 1959. Über den Tagesrhythmus der Singvögel im arktischen Sommer. Jour. für Ornith., **100**: 84–89.—In Arctic Sweden (68° 21.5 N.) during June, song and flight activity of songbirds began to drop after 7:00 P.M., reached a minimum between 10:00–11:00 P.M., and began to rise again after midnight.—E. E.

KILHAM, L. 1959. Early reproductive behavior of Flickers. Wilson Bull., **71**: 323–336.—The activities of *Colaptes auratus* from midwinter to egg laying are described, based on observations of wild and captive birds.—J. T. T.

LEHTONEN, L. 1958. [On the movements of tit flocks in the coniferous and mixed forests of southern Finland.] Ornis Fennica, **35**: 76–93.—The organization and movements of wandering bird flocks of which one or more species of tits generally form the nucleus. (In Finnish; German summary and table captions.)—E. E.

NICOLAI, J. 1959. Familientradition in der Gesangsentwinklung des Gimpels (*Pyrrhula pyrrhula* L.). Jour für Ornith., **100**: 39–46.—The Bullfinch learns its song chiefly from hearing its father. A young Bullfinch reared by canaries learned a canary song; four years later the descendants of this bird still sang unchanged the canary phrases.—E. E.

RAITASUO, K. 1958. Beobachtungen über brutzeitliches Verhalten beim Teich- und beim Schilfrohrsänger. Ornis Fennica, **35**: 94–108.—Observations on the behavior of Reed and Sedge Warblers (*Acrocephalus scirpaceus* and *A. schoenobaenus*) in protecting nestlings from the weather, the heat reactions of the adults, and nest sanitation, including experiments to test the size, shape, and color of objects that would release the sanitation activity. (In German; Finnish summary.)—E. E.

RASPET, A. 1960. Biophysics of bird flight. Science, **132**: 191–200.—A rather technical paper for most ornithologists. Covers soaring (rather than flapping) flight almost exclusively; the physical mechanism of bird propulsion by flapping is surprisingly poorly understood. It is concluded that experiments with anything other than living birds (models, mounted birds, frozen birds) are of dubious value; productive past experiments (wind tunnel, following in sail planes) are described and additional experiments proposed. Many gaps in our knowledge (*i.e.*, how do birds locate thermal upcurrents at a distance?) are pinpointed. A valuable review.—K. C. P.

RICHARDS, T. J. 1958. Concealment and recovery of food by birds, with some relevant observations on squirrels. Brit. Birds, **51**: 497–508.

ROLLIN, N. 1958. Late season singing of the Yellowhammer. Brit. Birds, **51**: 290–303.

ROTHSCHILD, M. and C. LANE. 1960. Warning and alarm signals by birds seizing aposematic insects. Ibis, **102**: 328–330.—Many aposematic insects are not only unpalatable but possess chemical substances causing pain or distress in the predator. Learning in birds confronted with such insects is described and discussed.—J. W. H.

SIMMONS, K. E. L. 1957. A review of the anting-behaviour of passerine birds. Brit. Birds, **50**: 401–424.—Two forms of anting are distinguished: active (the bird applies crushed ants to the underside of the wing and tail with its bill) and passive (the bird allows ants to crawl on to its plumage). The distribution of these behavior patterns in passerine birds is summarized. Active anting has probably evolved from preening movements and may function as an aid in preening.—F. M.

SMYTHIES, B. E. 1960. Subspecific variation in birds' songs and call-notes. Ibis, **102**: 134–135.—Twenty species common to Borneo and Burma but represented in each place by different subspecies are compared as to song and call notes by an author familiar with both forms in each case. In each subspecies pair, vocalizations are similar, in some cases identical. When only similar, that of the Bornean forms are often thinner or less resonant, correlating with smaller size of most Bornean forms.—J. W. H.

THIELCKE, G. 1959. Über Schlafgewohnheiten des Gartenbaumläufers *(Certhia brachydactyla)* und des Waldbaumläufers *(Certhia familiaris)*. Jour. für Ornith., **100**: 25–38.—On the sleeping habits of tree creepers, with excellent photographs.—E. E.

WILLIS, E. 1960. Red-crowned Ant-Tanagers [*Habia rubica*], Tawny-crowned Greenlets [*Hylophilus ochraceiceps*], and forest flocks. Wilson Bull., **72**: 105–106.—The behavior of several flocking species in British Honduras is described.—J. T. T.

DISEASES AND PARASITES

ASH, J. S. 1960. A study of the Mallophaga of birds with particular reference to their ecology. Ibis, **102**: 93–110.—An important summary of facts on the biology of these parasites, with data on their temperature and food requirements, effects on birds, parasite-host relationship, changes in infestation, distribution on host, and valuable suggestions for collection, examination, and sampling of Mallophaga. Infestation of bird species in Great Britain and Sweden is discussed.—J. W. H.

BANKOWSKI, R. A., R. E. CORSTVET, and G. T. CLARK. 1960. Isolation of an unidentified agent from the respiratory tract of chickens. Science, **132**: 292–293.—An undescribed filterable virus causing hemagglutination of red blood cells was isolated from tracheae of young chickens simultaneously afflicted with infectious laryngotracheitis. The latter disease masked the effects of the unknown virus, which causes, by itself, a mild and transient illness. The new agent appears to be a member of the myxovirus group.—K. C. P.

COOMBS, C. J. F. 1960. Ectoparasites and nest fauna of rooks and jackdaws in Cornwall. Ibis, **102**: 326–328.

MEYER, K. F. and B. EDDIE. 1960. Feather mites and ornithosis. Science, **132**: 300.—Ornithosis virus has been isolated from several species of poultry ectoparasites, suggesting for the first time that this too may be a vector-borne infection. [Authors' summary.]

DISTRIBUTION AND ANNOTATED LISTS

BOYD, J. M. 1958. The birds of Tiree and Coll. Brit. Birds, **51**: 41–56, 103–118.—Detailed records for two islands of the Inner Hebrides.

BUXTON, E. J. M. 1960. Winter notes from Madeira. Ibis, **102:** 127–129.—An annotated list comprises the first published observations on wintering birds from this island in about 50 years.—J. W. H.

HINDWOOD, K. A. and A. R. MCGILL. 1958. The birds of Sydney (County of Cumberland) New South Wales. 128 pp., map, 19 photo. pls. Royal Zool. Soc. of N.S.W., 28 Martin Place, Sydney, Australia. Price, 12/6.—While essentially a check-list (giving local status and habitat) of the 377 native and 15 introduced species recorded in the vicinity of Australia's most populous city, this booklet also provides a succinct statement (usually under four lines) of the identifying characters of each species. Photographs of habitats and of a number of birds add to the usefulness of the work. Though subspecies are not mentioned, systematists will be interested in a list of birds erroneously recorded, for many of which Sydney is stated in the literature to be the type locality.—E. E.

JAMES, D. and J. R. PRESTON. 1959. An inventory in 1957 of the distribution of the Wild Turkey (*Meleagris gallopavo silvestris* Vieillot) in the Ozark Plateau region of Arkansas. Proc. Ark. Acad. Sci., **13:** 83–90.

JOHANSEN, H. 1959. Die Vogelfauna Westsibiriens. III. Teil (Non-Passeres). 6. Fortsetzung: Anseres I *(Cygnus-Casarca)*. Jour. für Ornith., **100:** 60–76. —Continuing the annotated catalogue of West Siberian birds (swans, geese, and shelducks). Data on distribution, ecology, and breeding biology.—E. E.

JÓZEFIK, M. 1960. Modifications of the south-west border of the range of *Erythrina e. erythrina* (Pall.) during the last two hundred years. Acta Ornithologica, **5:** 307–324.—Two expansion waves are documented from the south-west boundary of this species, the first from the 1790's to the 1880's, following a regression, the second, from the 1930's to date. The factors that might have caused these range fluctuations are briefly discussed. (In Polish; with Russian and English summary.)—M. D. F. U.

KEVE, A. 1960. Nomenclator Avium Hungariae. Hungarian Ornithological Institute, Budapest. 89 pp.—This publication replaces the 1938 check-list of the birds of Hungary. The bilingual text also gives the whereabouts of the documentary specimens of each species. There is a hypothetical list. The list of species that occurred up to 1938 in the Carpathian Basin but outside the present boundaries of Hungary is included, but not brought up to date. (In Hungarian and German.)—M. D. F. U.

KOEPKE, M. 1958. Die Vögel des Waldes von Zárate (Westhang der Anden in Mittelperu). Bonn. Zool. Beitr., **9:** 130–193.—Annotated list of birds found in temperate woodland on the west slope of the Andes (alt. 2500–3500 m.) near Lima, Peru. In this hitherto undescribed biotope the author discovered a new genus and species of cotingid, *Zaratornis stresemanni*, of which the female occurs there in some numbers for two months prior to the breeding season, but of which the male is still unknown. The paper contains much data on ecology, vocalizations, and behavior.—E. E.

KUMERLOEVE, H. 1960. [On the distribution of the Squacco Heron, *Ardeola ralloides* (Scop.) in S.W. Asia.] Acta Ornithologica, **5:** 301–306.—Summary based on personal observations and comprehensive literature search. (In German; with Polish and Russian summary.)—M. D. F. U.

KURODA, N. 1960. Analysis of sea bird distribution in the northwest Pacific Ocean. Pacific Science, **14:** 55–67.—Sea bird census made during a research cruise from Japan to the western Bering Sea, June–July 1954. Data presented include population density, correlation of the latter with food supply, and corre-

lation of distribution of individual species with sea zones defined in the paper. —K. C. P.

LÖHRL, H. 1959. Beitrag zur Avifauna Korsikas. Jour. für Ornith., **100**: 79–83. —Notes on Corsican birds.

MICZYNSKI, K. 1960. [Ornithological notes from the East Carpathians /Gorgany; Czornahora/.] Acta Ornothologica, **5**: 333–345.—(In Polish; with Russian and German summary.)

NICHOLSON, E. M., I. J. FERGUSON-LEES, and P. A. D. HOLLOM. 1957. The Camargue and the Coto Donana. Brit. Birds, **50**: 497–519.—A comparison, in the light of recent studies, of the avifauna of these two famous regions in southern France and south-west Spain.—F. M.

PYMAN, G. A. 1959. The status of the Red-crested Pochard in the British Isles. Brit. Birds, **52**: 42–56.

RASANEN, T. 1959. [On Razorbill and Pigeon Guillemot colonies in the Simo archipelago.] Ornis Fennica, **36**: 94–97.—(In Finnish; with German summary.)

STAEBLER, A. E. 1959. Subspecies of the Canada Goose in Michigan. Wilson Bull., **71**: 344–347.—Four subspecies of *Branta canadensis* were tentatively identified from migrant geese in Kalamazoo County, Michigan.—J. T. T.

STEGMANN, B. 1958. Die Herkunft der eurasiatischen Steppenvögel. Bonn. Zool. Beitr., **9**: 208–230.—The derivation (geographical) of the avifauna of the Eurasian steppes.—E. E.

SZARSKI, K. 1955. The birds of Wrocław in 1946–1952. Acta Ornithologica, **5**: 1–49.—Avifaunistic notes; ruins created new nesting habitat, first for rock dwellers, later, when crumbled down, for birds of barren and semi-open areas. (In Polish; with Russian and English summary.)—M. D. F. U.

TOMKINS, I. R. 1958. The birdlife of the Savannah River Delta. Gaviiformes through Charadriiformes. Georgia Ornith. Soc., Occ. Publ., no. **4**: 1–68. 4 figs. incl. map. Price, $1.50.—This river forms the boundary between South Carolina and Georgia. The annotated list of species is introduced by useful sections on the ecology of the area, which consists mainly of marshes. Of general interest are the data on the favored habitats of the shorebirds and breeding forms.—E. E.

WILEY, R. H., JR. 1959. Birds observed during two Atlantic crossings. Wilson Bull., **71**: 364–371.—Twelve species of oceanic birds observed between New York and France or England.—J. T. T.

WILLIAMS, G. R. 1960. The birds of the Pitcairn Islands, central south Pacific Ocean. Ibis, **102**: 58–70.—A species list based on observations made in late 1956 is presented. Twenty-eight forms are listed and the numbers found on each island in the group given. The avifauna is oceanic and migrant, the land birds having Polynesian affinities (most closely to the Austral Islands and Tuamotu group), and so far as known no native species have become extinct. *Gallus gallus* and *Phasianus colchicus* were introduced on Pitcairn; the former is now feral, the latter extinct.—J. W. H.

ECOLOGY AND POPULATION

COULSON, J. C. and E. WHITE. 1960. The effect of age and density of breeding birds on the time of breeding of the Kittiwake *Rissa tridactyla*. Ibis, **102**: 71–86.—Differences in time of breeding in a colony of Kittiwakes were recorded over an eight-year period. Females breeding for the first time began about 10 days later than females breeding for at least the fourth time. Older colonies

have fewer birds breeding for the first time than younger colonies. But these factors do not account for differences in times of breeding of the colonies; the latter is directly related to density of birds. Maximum nest density is usually related to rock structure, but in one colony density is probably determined by minimum distance that neighbors can tolerate each other. Density also is directly correlated with earliness of return to the colony in spring. Correlation is made between onset and progress of breeding phases with maximum density, range in density, and presence of low-density areas. Social stimulation is different from that envisaged by Darling; effective distance was five feet and tended to produce a longer breeding season.—J. W. H.

CREUTZ, G. 1958. Wo fehlt der Haussperling als Brutvogel. Falke, **5**: 98–101, 116–119.—German localities where the House Sparrow *(Passer domesticus)* is absent as a breeder, and the probable reasons.—E. E.

CZARNECKI, Z. 1956. Ecological observations of birds in the Golecin Wood near Poznań in 1952. Acta Ornithologica, **5**: 113–158.—Ecological study of a 26.9 ha. suburban wood (pine planations, deciduous woodland with pond) with phenological data and breeding census (average density 1,304 pairs/sq. km.). Nests were mapped and habitat subdivisions analyzed; 57 per cent of nests were destroyed by people and feral and wild predators. Breeding densities seemed to depend on suitable nest sites rather than on proximity of ample food. (In Polish; with Russian and English summary.)—M. D. F. U.

DRINNAN, R. E. 1958. Observations on the feeding of the Oystercatcher in captivity. Brit. Birds, **51**: 139–149.—Captives ate 230–260 cc. mollusc flesh per day. Estimated food intake of wild birds was higher. Feeding rate in the dark was about half that in light. Wild birds estimated to be eating an amount of dry food equal to 17.5 per cent of their own live body weight per day.—F. M.

FRITH, H. J. 1959. The ecology of wild ducks in inland New South Wales. I Waterfowl habitats; II Movements; III Food habits; IV Breeding. C.S.I.R.O. Wildlife Research, **4**: 97–107, 108–130, 131–155, 156–181.—An important study of Australian ducks in an area subject to periodic drought. In Part I habitats are described and shown to fluctuate widely in amount each year. In Part II the highly erratic and extensive movements characteristic of some ducks are shown to be associated with changes in habitat and to vary between species. In Part III food habits of six common species are compared, and the ecological significance of diet variation is shown. Part IV is concerned with the effect of water levels on the breeding of three species. The differences in response are related to specific habitats and food habits of the young. The main species dealt with are *Anas gibberifrons, A. superciliosa, A. rhynchotis, Chenonetta jubata, Malacorhynchus membranaceus,* and *Aythya australis.*—J. P. R.

GIBB, J. A. 1960. Populations of tits and goldcrests and their food supply in pine plantations. Ibis, **102**: 163–208.—A description of a five-year study to test the hypothesis that populations of tits and goldcrests *(Regulus regulus)* are controlled by food shortage and to assess the effect of predation by birds on populations of forest insects.—J. W. H.

GOODACRE, M. J. and D. LACK. 1959. Early breeding in 1957. Brit. Birds, **52**: 74–83.—Following an unusually mild winter and early spring, seven resident passerine species and one resident owl laid 6-12 days earlier than usual. Less-certain evidence is given for other British resident species. Temperature is thought to act directly on the birds.—F. M.

HOFFMANN, L. 1958. An ecological sketch of the Camargue. Brit. Birds, **51**: 321–350.—Describes the habitats and vertebrate fauna with special emphasis on birds. Includes a selected bibliography on the region.—F. M.

LINKOLA, P. 1959. [On bird census methods in inland waters.] Ornis Fennica, **36**: 66–78.—The span of nesting period on a lake necessitates at least four censuses throughout May and June to give a complete record of bird densities. (In German.)—M. D. F. U.

MATHESON, C. 1957. Further Partridge records from Wales. Brit. Birds, **50**: 534–536.—Total bags of *Perdix perdix* on two estates from 1866 to 1950.—F. M.

PINOWSKI, J. 1959. Factors influencing the number of feeding Rooks *(Corvus frugilegus frugilegus* L.) in various field environments. Ekologia Polska—Seria A, **7**: 435–482.—Number of feeding birds varies with the type of fields. More Rooks are found in sparsely wooded fields than in those densely wooded, during the period of intensive feeding. Rooks call far less frequently than Jackdaws while feeding, but they call as often as Jackdaws when alighting with or flying over the feeding flock. Large feeding flocks were found in treeless field areas, while in fields with many clumps of trees flocks were small. Good visibility in open country is thought to favor "passive cooperation" in searching for food.—F. M.

SIIRA, J. 1959. [Notes concerning the census of breeding populations of species of the genus *Anas.*] Ornis Fennica, **36**: 98–107.—Egg-laying time and the beginning of the incubation period was found most suitable for census, and repeated counts were found necessary. (In Finnish; with English summary.) —M. D. F. U.

SOUTHERN, H. N. 1959. Mortality and population control. Ibis, **101**: 429–436. —Death rate is considered to be a more important density-dependent regulator of bird populations than birth rate. Data on Tawny Owls uphold the importance of mortality and indicate that it is a factor in populations that seems to control level by territorial spacing. Southern argues that birth rate is a part of mortality, since "it is a fine point whether an egg should fall into different categories according to whether it dies inside or outside the parent's body"; in other words, repression is effective mortality just as is a young bird starving to death.—J. W. H.

STINE, P. M. 1959. Changes in the breeding birds of Bird Haven Sanctuary over a period of forty-five years. Wilson Bull., **71**: 372–380.—The area includes woods and fields once owned by Robert Ridgway in Richland County, Illinois, and the 45 years spanned began with a few years of his observations and ends with 10 years of the author's observations. Eighty-one species of birds are noted, most of which were present in all years concerned.—J. T. T.

SUMMERS-SMITH, D. 1959. The House Sparrow *Passer domesticus:* population problems. Ibis, **101**: 449–454.—House Sparrows are partial to areas of dense human population (ratio, one sparrow: five humans). Estimates of numbers of House Sparrows per acre in urban, suburban, and rural areas in Great Britain, Germany, and U.S., among other regions, allow estimates of total populations of sparrows (10 million in Great Britain). Seasonal composition and mortality in populations in Great Britain are discussed. Food supply and colonial behavior seem to be important factors in control of population size.—J. W. H.

VALVERDE, J. A. 1958. An ecological sketch of the Coto Donana. Brit. Birds, **51**: 1–23.—Describes the different habitats and the vertebrate fauna of each. —F. M.

WILLIAMSON, K. 1958. Population and breeding environment of the St. Kilda and Fair Isle Wrens. Brit. Birds, **51**: 369–393.

WYNNE-EDWARDS, V. C. 1959. The control of population-density through social behaviour: a hypothesis. Ibis, **101**: 436–441.—It is a fact that size of population and food supply of a given species are directly correlated. Population density arises from the activity of the animals, implying internal control or self-regulated density. The author hypothesizes that animals have become adapted to this controlling ability and are able to limit the population to its optimum level. Further it is suggested that this result is achieved by "imposing artificial goals [such as are achieved in social displays, singing] as substitutes for competing for food. . . ." These goals impose a ceiling density *below* starvation level and direct combat for food.—J. W. H.

GENERAL BIOLOGY

ALLEN, F. G. H. 1960. A nest of the Spine-tailed Swift *Chaetura g. gigantea*. Ibis, **102**: 126–127.—The first known nest of this nominate race is described from the Cameron Highlands, Malaya. The nest differs from that described by Lack for *C. g. indica;* a comparison of nest site and construction in the two races is made.—J. W. H.

BARTKOWIAK, S. 1959. Contributions to the biology of the great tit, *Parus major* (L.), during the breeding period. Acta Ornithologica, **5**: 217–232.—Feeding frequencies were studied and found to be greatest between the 8th and 15th days after hatching at the five nests studied. While atmospheric conditions are decisive in the first days of nestling life, later the size of clutch and availability of food also influence the length of nestling period. (In Polish; with Russian and English summary.)—M. D. F. U.

BATESON, P. P. G., and R. C. PLOWRIGHT. 1959. The breeding biology of the Ivory Gull in Spitsbergen. Brit. Birds, **52**: 105–114.

BROWN, L. H. 1960. The African fish eagle *Haliaeetis vocifer* especially in the Kavirondo Gulf. Ibis, **102**: 285–297.—Data are presented on numbers, movements, territories, home ranges, mutual stimulation to breed, breeding and hunting difficulties (caused by overcrowding), food habits, breeding cycle, breeding season (and its relation to food supply and climate), and breeding success.—J. W. H.

BURTON, P. J. K. and M. H. THURSTON. 1959. Observations on Arctic Terns in Spitsbergen. Brit. Birds, **52**: 149–161.—Discusses diurnal rhythms, predation, nesting associations, mobbing, and feeding.—F. M.

CAMPBELL, B. 1959. Attachment of Pied Flycatchers *Muscicapa hypoleuca* to nest-sites. Ibis, **101**: 445–448.—*M. hypoleuca* was studied on nesting grounds of 60 acres of oakwood in Gloucestershire from 1947–58. The birds utilized 250 nest boxes on 200 trees scattered at about 50-yard intervals. Data are given on frequency of birds returning to nests where born and/or where previously nested. Males proved to have a closer attachment to the previous nesting site (average return to 125 yards away compared with 175 yards for female). Nestlings show no attachment to birth site. Failure of some adults to return to exact former nest site is probably primarily due to existence of many equally suitable sites.—J. W. H.

COX, G. W. 1960. A life history of the Mourning Warbler. Wilson Bull., **72**: 5–28.—The breeding activities of *Oporornis philadelphia* were studied in the

Itasca State Park, Minnesota. Described are habitats, territories, voice, nesting, and care of young after they leave the nest.—J. T. T.

GERBER, R. 1958. Die Rohrdommel [*Botaurus stellaris*]. Falke, **5**: 111–116.—General account of biology of the European Bittern.—E. E.

GILLHAM, E. H. 1958. Further notes on the Tufted Duck in St. James's Park, London. Brit. Birds, **51**: 413–426.—Study of the breeding and postbreeding phases in *Aythya fuligula*. Topics discussed are nonbreeders, spans of nesting, hatching, fledging and molt periods, mixed broods, clutch and brood sizes, unattached young and their adoption by unattached females, desertion of the young by the female, duckling mortality, the wing molt in adult females, and postbreeding movements.—F. M.

HANGSTROM, B. 1959. Ur gökytans [*Jynx torquilla*] familjeliv. Fauna och Flora, **1959**: 1–8.—The family life of the Wryneck. Observations suggest that the parents try to induce the smaller young to leave the nest to join the older siblings. (In Swedish; English summary.)—E. E.

HAUSER, D. C. 1959. Notes on pairing and nest-building of mismatched vireos. Wilson Bull., **71**: 383–384.—A female *Vireo solitarius* mated to a male *V. flavifrons*, at Fayetteville, North Carolina, built a nest with proportions typical of her species. She was later replaced by a female *V. flavifrons*, which worked on the nest, but it was never used.—J. T. T.

LØVENSKIOLD, H. L. 1960. The Snow Petrel *Pagodroma nivea* nesting in Dronning Maud Land. Ibis, **102**: 132–134.—Nesting places of the Snow Petrel in the Antarctic south and east of "Norway Station" are listed. The birds breed in colonies well inland where the mountains meet the glacier. Here they lay in burrows and incubate the eggs, which rest against the belly skin and on the long breast feathers. When approached they eject an oily, odorless spray the color of tomato juice. This substance hardens to rocklike consistency and coats the entrances and vicinities of burrows. Skuas are associates of the petrels, preying on the young.—J. W. H.

MACNAE, W. 1960. Greater flamingoes eating crabs. Ibis, **102**: 325–326.—*Phoenicopterus ruber* feeds on soldier crabs, *Dotilla fenestrata*, on sand flats near the island of Inhaca, entrance of Bay of Lourenço.—J. W. H.

MEBS, T. 1958. Beitrag zur Siedlungsdichte und Brutbiologie des Mäusebussards (*Buteo buteo* L.). Vogelwelt, **79**: 161–170.—Data on population density and breeding biology of the Common Buzzard.—E. E.

TOMKINS, I. R. 1959. Life history notes on the Least Tern. Wilson Bull., **71**: 313–322.—*Sterna albifrons* has decreased greatly in the vicinity of Savannah, Georgia, since 1930, for no known cause. Courtship and nesting are briefly discussed.—J. T. T.

WARNCKE, K. 1958. Zur Brutbiologie des Schwarzstirnwürgers *(Lanius minor)*. Vogelwelt, **79**: 177–181.—On the breeding biology of the Lesser Gray Shrike.

WARNER, D. W. 1959. The song, nest, eggs, and young of the Long-tailed Partridge. Wilson Bull., **71**: 307–312.—*Dendrortyx macroura*, observed along the border of the Mexican States of Morelos and Mexico.—J. T. T.

WAYNE, P. and G. F. JOLLY. 1958. Notes on the breeding of the Iceland Gyr Falcon. Brit. Birds, **51**: 285–290.

WENDLAND, V. 1958. Der Schreiadler [*Aquila pomarina*]. Falke, **5**: 6–13.—General biology (particularly breeding) of the Lesser Spotted Eagle in north Germany.—E. E.

WILLIAMS, G. 1959. Some ecological observations on the Purple Heron [*Ardea purpurea*] in the Camargue. La Terre et la Vie, 1959: 104–120.—Data on annual cycle, migration, breeding sites (*Phragmites* beds), reproduction, food habits, etc. (In English; French summary.)—E. E.

MANAGEMENT AND CONSERVATION

BOYD, H. 1959. The composition of goose populations. Ibis, **101**: 441–445.—Knowledge of changes in size and composition of populations is important in conservation of geese. Examples are cited of long-term studies in the U.S., and recommendations made for similar work in Great Britain and on the European continent. Although banding has been helpful, direct observation of flocks is proving valuable in determining age structure, breeding success and mortality of flocks. New information on populations and habits is presented and application to management discussed.—J. W. H.

BURKHOLDER, P. R. 1960. Penguins thrive on antibiotic plankton. Parks and Recreation, **43**: 264.—Penguins feed on euphausids, *Euphasia superba*, which exhibit strong antibacterial properties against aerobic bacteria in some birds, and against all bacteria in the upper gastrointestinal segments of other birds. The source of the antibiotic is a yellow-green alga, *Phaeocystis poucheti*, eaten by the euphausids. Perhaps, penguins would thrive in captivity if they were kept cool and provided with special feeds.—R. T. R.

HANSON, H. C. 1959. The incubation patch of wild geese: its recognition and significance. Arctic, **12**: 139–150.—A discussion of the use of the incubation patch as an aid in population studies. In Canada Geese, presence or absence of the patch (or the refeathered area) can be used throughout the flightless period, in addition to cloacal characters, to distinguish older females from yearlings and adult females from adult males. At this time the patch could give a measure of the proportion of females that have laid eggs, and thus a measure of the extent of nonbreeding. The refeathered patch cannot be reliably identified in winter.—F. M.

MURTON, R. K. 1960. The effect on Wood-pigeon breeding of systematic nest destruction. Annals of Applied Biology, **48**: 95–106.—*Columba palumbus* is considered an agricultural pest in some parts of England. Nest destruction as a means of control was tested, and found to reduce the number of fledged young in test areas to 37 per cent of normal expectation. Nest destruction is somewhat more expensive (figuring labor costs) than shooting, but is more efficient and can be done by less skilled employees.—K. C. P.

REUTHER, R. 1960. We're learning how to feed albatrosses. Parks and Recreation, **43**: 267.—Successful maintenance of albatrosses in captivity requires sufficient NaCl in their diets. At the Cleveland Zoo such birds are fed 18½ grains of salt and one multivitamin capsule as a precautionary measure daily inserted in fish. Almost any fish is suitable food. Some birds are self-feeders and others require force feeding.—R. T. R.

MIGRATION AND ORIENTATION

ALLEN, R. H. and G. RUTTER. 1958. The moult migration of the Shelduck from Cheshire in 1957. Brit. Birds, **51**: 272–274.

BELLROSE, F. C. and J. G. SIEH. 1960. Massed waterfowl flights in the Mississippi flyway, 1956 and 1957. Wilson Bull., **72**: 29–59.—The tremendous flights of

waterfowl occurring on 6–8 November 1956 and 23–25 October 1957 are described, especially as they were observed crossing the northern states in the Mississippi Valley. Elevation, direction, effect of geography on direction, speed, and the associated weather are included.—J. T. T.

BIRD MIGRATION. A Bulletin of the British Trust for Ornithology. Vol. 1. No. 1. December 1958.—A new journal, edited by Kenneth Williamson, the recently appointed Migration Research Officer of the B.T.O., will be published twice yearly. The scope of the journal is similar to that of Audubon Field Notes; detailed reports from the network of British Bird Observatories, documenting the spring and fall migrations, with digests and analyses of special topics. This publication will be welcomed especially by students of migration in Britain and on the continent.—F. M.

BOASE, H. 1959. Shelduck counts in winter in east Scotland. Brit. Birds, **52**: 90–96.

BROWNE, P. W. P. 1958. A North Atlantic transect in September. Brit. Birds, **51**: 93–99.

BROWNLOW, H. G. 1960. Migrational fidelity in Egypt. Ibis, **102**: 126.—Olivaceous Warblers, *Hippolais pallida*, are shown by banding to return to previous nesting areas to breed. Fidelity of Willow Warblers, *Phylloscopus trochilus*, and Garden Warblers, *Sylvia borin*, to migration routes is revealed, as well as fidelity to wintering areas of Stonechat, *Saxicola torquata*, and Chiffchaff, *Phylloscopus collybita*.—J. W. H.

HOFFMANN, K. 1959. Über den Einfluss verschiedener Faktoren auf die Heimkehrleistung von Brieftauben. Jour. für Ornith., **100**: 90–102.—On the influence on homing by carrier pigeons of various factors (age, training, failure to keep in training, direction, locality).—E. E.

JONES, H. I. 1957. Some observations on birds in the North Atlantic. Brit. Birds, **50**: 528–534.—Observations in August from a weather ship 300 miles south of Iceland.—F. M.

KUMERLOEVE, H. 1957. Ornithologische Beobachtungen im "Zubringerraum" (Bulgarisch-Rumänische Schwarzmeerküste) des Bosporuszuges. Bonn. Zool. Beitr., **8**: 248–274.—Bird migration observations on the Black Sea coast of Bulgaria and Roumania.—E. E.

LACK, D. 1960. Migration across the North Sea studied by radar. Part 2. The spring departure 1956–59. Ibis, **102**: 26–57.—Data were collected from late February to late April in four years. Bird echoes were most common around 9:00 P.M., with a smaller peak soon after dawn. Volume of emigration was influenced by internal state of the bird, temperature, wind speed, rain, and cloud cover. There was more migration in warm than cold weather in February and March but not later. Marked temperature change had no immediate effect. Morning migration was visible from the ground with opposed but not with following winds. Most migration was below 5,000 feet, some to 13,000 feet. Migration was north of east with southerly winds, south of east with a northerly wind. Sense of direction but not sense of position seems to be maintained. With total overcast, migrants flew at random, gradually drifting with the wind. Observations of Starling flocks are described.—J. W. H.

LOFTS, B. and A. J. MARSHALL. 1960. The experimental regulations of *Zugunruhe* and the sexual cycle in the Brambling *Fringilla montifringilla*. Ibis, **102**: 209–214.—Captive Bramblings kept under light conditions of winter during normal migratory period showed no significant gonadal enlargement or evidence

of *Zugunruhe*. When photoperiod was increased (after normal migratory season) to 14½ hours, nocturnal unrest appeared. The Brambling does not come rhythmically into breeding condition as do young of xerophilous species (such as *Melopsittacus undulatus*). Accompanying light-induced unrest was fat deposition and gonad enlargement in males. Experimentation with castrates suggests that *Zugunruhe* and migration can occur in absence of sex hormones. —J. W. H.

McCartan, L. 1958. The wreck of Kittiwakes in early 1957. Brit. Birds, **51**: 253–266.

McLean, I. and K. Williamson. 1958. Waders at ocean Weather Ships in 1956. Brit. Birds, **51**: 152–156.

McLean, L. and K. Williamson. 1958. Migrant land-birds in the Western Approaches. Brit. Birds, **51**: 351–353.—Observations in April and October 1957 from a weather ship located in the Atlantic 500 miles from Land's End and 300 miles from the northwest corner of Spain.—F. M.

Mewaldt, L. R. and R. G. Rose. 1960. Orientation of migratory restlessness in the White-crowned Sparrow. Science, **131**: 105–106.—*Zonotrichia leucophrys gambelii* and *Z. l. pugetensis* were kept in a cage designed for continuous automatic recording of activity, at San Jose, California. During the normal migration period the birds showed strong orientation of nocturnal (but not diurnal) activity, toward the north in spring and south in fall. The more diffuse orientation in fall than in spring is ascribed to the birds being close to their normal wintering area but far from the breeding grounds.—K. C. P.

Nordström, G. 1958. Bird-banding in Finland in the years 1913–1957. Ornis Fennica, **35**: 113–121.—A list of species with the number of each banded and recovered, percentage of recoveries, and the countries in which recoveries have been made. Of 215 species, 259,367 individuals banded, 6,457 (2.4 per cent) were recovered. The longest distances (to South Africa) were travelled by an Arctic Tern (10,860 km.) and a Common Tern and a Spotted Flycatcher (over 10,550 km.). One Lesser Black-backed Gull was recovered 26 years and 8½ months after being banded as a nestling.—E. E.

Rappe, A. 1959. Contribution a l'étude de la migration vespérale. Gerfaut, **49**: 83–90.—In autumn certain diurnal migrants resume migration for a couple of hours before sunset. Among such vesper migrants is the Barn Swallow.—E. E.

Sage, B. L. and B. King. 1959. The influx of Phalaropes in autumn 1957. Brit. Birds, **52**: 33–42.

Salomonsen, F. 1959. [Eighth preliminary list of recoveries of birds ringed in Greenland.] Dansk Orn. Foren. Tidsskr., **53**: 31–39.—The banding data indicate that most Greenland migrants winter in Europe. Among the American recoveries: King Eiders breeding in Arctic Canada migrate to molt in western Greenland; the high Arctic race of the Black Guillemot *(Cepphus grylle ultimus)* banded in Greenland recovered on Baffin Island; Parasitic Jaeger banded on 19 July taken less than a month later 15 August 1958 in Newfoundland. A Snow Bunting banded in N.E. Greenland taken in N.E. Russia; as this is the second similar recovery, the writer believes that the N.E. Greenland population crosses the Polar Sea to northern Russia to winter in the steppes. (In Danish; full English summary; banding data self-explanatory.)—E. E.

Smith, F. R. 1959. The Crossbill invasion of 1956 and the subsequent breeding in 1957. Brit. Birds, **52**: 1–9.

SWIRSKI, Z. 1956. [Results of Polish bird ringings. The Grey Heron (*Ardea c. cinerea* L.).] Acta Ornithologica, **5**: 51–75.—315 returns out of 2509 Polish banded birds (1932 to 1950) and 231 returns of foreign banded birds indicate wintering grounds in the S. W. Mediterranean area, and S. Italy–Tunisia. Numerous cases of strong philopatry (return to birth place) are indicated. Longevity and mortality are also calculated. (In Polish; with Russian and German summary.)—M. D. F. U.

SZCZEPSKI, J. B. and M. W. SZCZEPSKI. 1956. Compte rendu de l'activité de la Station Ornithologique pour l'annéé 1950. Acta Ornithologica, **5**: 77–112.—This is essentially a banding report of the Station personnel (Director: J. B. Szczepski) and volunteers throughout Poland. 6,406 birds belonging to 99 species were banded, 132 recovered. (In Polish; with Russian and French summary.)—M. D. F. U.

SZCZEPSKI, J. B. and M. W. SZCZEPSKI. 1957. Report of the Ornithological Station for 1951. Acta Ornithologica, **5**: 161–209.—10,613 birds were banded, 214 recovered in Poland. (In Polish; with Russian and English summary.)—M. D. F. U.

SZCZEPSKI, J. B. and M. W. SZCZEPSKI. 1959. Report of the Ornithological Station for 1952. Acta Ornithologica, **5**: 233–282.—12,557 birds were banded, 224 recovered in Poland. Research was continued in use of birds for control of the Colorado beetle, and on wintering waterfowl of the Wisła river. (In Polish, with Russian and English summary.)—M. D. F. U.

THOMSON, A. L. 1958. The migrations of British Hawks (Accipitridae) as shown by ringing results. Brit. Birds, **51**: 85–93.

THOMSON, A. L. 1958. The migrations of British Falcons (Falconidae) as shown by ringing results. Brit. Birds, **51**: 179–188.

VAUGHAN, R. 1960. Notes on autumn migrants in Morocco. Ibis, **102**: 330–332.

VLEUGEL, D. A. 1959. [About the most probable method of wind orientation in migrating Chaffinches.] Ornis Fennica, **36**: 78–88.—The author argues for the hypothesis that the bird, sun-oriented when starting, keeps its direction by anemotaxis. (In German.)—M. D. F. U.

WEST, J. D. and J. M. SPEIRS. The 1956–1957 invasion of Three-toed Woodpeckers. Wilson Bull., **71**: 348–363.—During the 1956–57 fall and winter season 59 records of *Picoïdes tridactylus* and 293 records of *P. arcticus* were made in southeastern Canada and northeastern United States. The data are fully reported.—J. T. T.

WILLIAMSON, K. 1958. Bergmann's Rule and obligatory overseas migration. Brit. Birds, **51**: 209–232.—In a polytypic species the body size of a subspecies tends to increase with the decreasing mean temperature of its habitat. The selection pressures responsible for this tendency have been thought to be operating on the breeding grounds or on the wintering grounds. Evidence is presented to show that in some species *(e.g., Oenanthe oenanthe, Turdus musicus, Falco columbarius, Tringa totanus)* selection operates during the period of migration. Races making a long overseas flight have greater body weight and longer wing and tail.—F. M.

ZABŁOCKA, T. 1959. Spring arrival of the White Stork, *Ciconia ciconia* (Linn.), in Poland in 1946–1952. Acta Ornithologica, **5**: 283–299.—Reports of 2842 first arrival dates from seven years are evaluated. (In Polish; with Russian and German summary.)—M. D. F. U.

PHYSIOLOGY

KIRKPATRICK, C. M. 1959. Testicular response in Bobwhites to interrupted dark periods. Wilson Bull., **71**: 337–343.—Pairs of *Colinus virginianus* were exposed to a daily cycle of nine hours of light, then seven of darkness, one of light, and seven of darkness. Sperm production began seven and 14 days after the treatment started, but the first egg was not produced until 61 days.—J. T. T.

LEHRMAN, D .S. 1959. Hormonal responses to external stimuli in birds. Ibis, **101**: 478–496.—Appropriate external stimuli seem to stimulate hormonal activity in birds: for example, stimuli arising from courtship behavior induce secretion of FSH in the female of many species while nesting material may cause secretion of LH. In many species, general environmental variables induce more rapid development in males than in females. Thus, males arriving at the breeding ground are usually closer to sexual maturation than females. The physiological-anatomical basis for the reflex causation of changes in hormonal levels due to external stimuli is established. Synchronization of male and female is due to hormonal excitation caused by mutual stimulation and that evoked by eggs and young.—J. W. H.

MARSHALL, A. J. 1959. Internal and environmental control of breeding. Ibis, **101**: 456–478.—The phases of the internal reproductive rhythm are discussed. The roles of external regulating factors (light, temperature, rainfall, territory, nest site and materials, food, behavioral interactions) are considered in turn. The sexual cycle and timing of breeding in different latitudes and environments are considered and correlated with migrational habits.—J. W. H.

PEIPONEN, V. 1959. [Color vision and the colored oil globules in the eye of birds.] Ornis Fennica, **36**: 88–94.—Field experiments indicated that three species of passerines showed color preference corresponding to their own plumage coloration. Microscopic study showed that the central part of their retina contains predominantly oil globulets of the corresponding color. This fact is interpreted as facilitating the species-specific color perception. (In German.) —M. D. F. U.

SCHMIDT-NIELSEN, K. 1960. The Salt-Secreting Gland of Marine Birds, in Symposium on Salt and Water Metabolism, Circulation, Vol. **21**: 955–967.—An important review article on the extrarenal excretion of Na, K, and Cl by the supra-orbital gland. More information is given on the anatomical structure, counter-current flow, and a counter-current multiplier system. Adrenaline and carbonic anhydrase inhibitors block secretion.—F. G. C.

SCOTHORNE, R. J. 1959. Histochemical study of succinic dehydrogenase in the nasal (salt secreting) gland of the Aylesbury Duck. Quart. Jour. Exp. Physiol., **44**: 329–332.—The distribution of succinic dehydrogenase in the nasal gland of the Aylesbury Duck (domestic Mallard) was studied histochemically. The enzyme concentration was high in the secretory tubules and low in the duct system. Concentration of the enzyme is apparently correlated with a concentration of mitochondria.—F. G. C.

SCOTHORNE, R. J. 1959. The nasal glands of birds: a histological and histochemical study of the inactive gland in the domestic duck. Jour. of Anat., **93**: 246–257.—Secretory cells of the gland are characterized by their eosinophilia and unusually abundant mitochondria. Serozymogenic and mucous elements are absent. Nasal glands are less obvious in the domestic duck than in wild mallards because of fresh-water habitat of former. Secretion was at rate of 400 m.eq/litre of Na and 500 m.eq/l. Cl.—F. G. C.

WOLFSON, A. 1960. The ejaculate and the nature of coition in some passerine birds. Ibis, **102**: 124–125.—In some passerines sperm are characteristically gathered into dense masses in a liquid exudate. Sperm in these tiny drops are highly motile and move radially. The tiny papilla protruding from the cloaca in at least some male passerines is inserted into the cloaca of females and the mass of sperm implanted at the mouth of the oviduct through the groovelike passageway in the papilla. Seasonal appearance of the protuberance may be related to reproductive success and reproductive isolation of species. Genital characters of nonpasserines are noted.—J. W. H.

TAXONOMY AND PALAEONTOLOGY

HALL, B. P. 1960. Variation in the African Black Tits, *Parus niger* and *Parus leucomelas*. Ibis, **102**: 116–123.—The relationship between Black and Grey Tits is discussed. Variable characters of the Black Tit are listed; five forms can be distinguished; the characters, ranges, and ecology of the five forms are listed, together with discussion of atypical populations and regional variation. Speciation, it is concluded, is taking place in many populations of *P. niger*, making assessment of relationships difficult. *P. n. niger* and *carpi* are considered specifically distinct from the others. *P. l. leucomelas* and *insignis* need more study in Uganda and Abyssinia; *purpurescens* is regarded as a race with further work needed.—J. W. H.

MAYAUD, N. 1958. La Gorge-bleue à miroir *Luscinia svecica* en Europe. Evolution de ses populations. Zones d'hivernage. Alauda, **26**: 290–301.—Taxonomy and winter ranges of the White-spotted Bluethroats of Europe.—E. E.

MOREAU, R. E. 1960. Conspectus and classification of the Ploceine Weaver-Birds. Ibis, **102**: 298–321.—Parts 1 and 2 of a four-part paper to be concluded in a subsequent number of the Ibis. Part 1 deals with allocation of genera to groups, and Part 2 deals with the author's Group A Ploceinae. Classification in past, rearrangement at specific level, plumage, environment, nests and nest sites, eggs and clutch size, food and beaks, size and proportions, and classification are discussed.—J. W. H.

PARKES, K. C. and D. AMADON. 1959. A new species of rail from the Philippine Islands. Wilson Bull., **71**: 303–306.—*Rallus mirificus*, new species, Luzon, Philippine Islands. A color plate illustrates the bird.—J. T. T.

PIMENTEL, R. A. "1959" [=1960]. Mendelian infraspecific divergence levels and their analysis. Syst. Zool., **8**: 139–159.—The first of two parts attempts to define "levels" ("patterns" would perhaps be a better word) of infraspecific differentiation, from the uniform, continuous population to the subspecies. The author, deploring the abuse of the latter category, defines it as "a physically isolated, obviously different entity that would crossbreed with the rest of its species IF contact occurred under natural conditions." The author accepts a consistent separation of 84 per cent in "several characters" as "meriting subspecific designation." The second part recommends "reliable procedures" for infraspecific analysis that appear to be utterly unrealistic for bird (and probably many other) taxonomists, presupposing complete freedom of choice of collecting localities and sample sizes. The author considers himself a "student of biometry," and his seeming disdain for most taxonomists is implicit throughout the paper. He calls his concept the "new" or "restricted" subspecies, as opposed to the "old," "unrestricted," or "broad" subspecies. The author steers a middle

course through the debate long filling the pages of "Systematic Zoology" by dwelling on the shortcomings of the viewpoints of extremists.—K. C. P.

SIBLEY, C. G. 1960. The electrophoretic patterns of avian egg-white proteins as taxonomic characters. Ibis, **102**: 215–284.—Electrophoretic profiles of egg-white proteins of 359 nonpasserines and the bearing of these on understanding taxonomic relationships is discussed by family. There is a detailed appendix giving profile data for all species studied and a phylogenetic tree.—J. W. H.

STARCK, D. 1959. Neuere Ergebnisse der vergleichenden Anatomie und ihre Bedeutung für die Taxonomie, erläutert an der Trigeminus-Muskulatur der Vögel. Jour. für Ornith., **100**: 47–59.—Observations on the light thrown by the trigeminal musculature of birds on their taxonomy—particularly the Accipitres (Falconiformes). The Falconidae and the owls are considered more closely allied than are the Falconidae to the Accipitridae, and the New World vultures Catartidae are also quite distinct.—E. E.

STOKOE, R. 1958. The spring plumage of the Cormorant. Brit. Birds, **51**: 165–179.—Discussions of plumage, size, and distribution suggest that the two European races of the Cormorant *Phalacrocorax c. carbo* and *Ph. c. sinensis* are not separable in the field, if at all. A cline of decreasing size and increasing greenness of gloss and whiteness of head from west to east is postulated.—F. M.

VAURIE, C. 1960. Systematic notes on Palearctic birds. No. 40. Caprimulgidae. Amer. Mus. Novitates, **1997**: 14 pp.—No races are recognized of *C. inornatus*, which is so variable that not even color phases can be defined. *C. indicus memnon* Koelz is a synonym of *C. i. hazarae*. *C. nubicus taruensis* is upheld, *contra* Mackworth-Praed and Grant. Four races of *C. europaeus* are accepted, *sarudnyi* Hartert being a synonym of *europaeus*. The population in England is shown to differ from continental birds, but below the subspecific level. *C. ruficollis* is definitely recorded from the Balearic Islands for the first time. Most authors admit only two races of *C. aegyptius*, but Vaurie also upholds *arenicolor* Severtzov, to which most of the casual extralimital records probably belong.—K. C. P.

VAURIE, C. 1960. Systematic notes on Palearctic birds. No. 41. Strigidae: the genus *Bubo*. Amer. Mus. Novitates, **2000**: 31 pp.—A detailed review of *B. bubo*, and a short note on *B. africanus*. Sixteen races of *B. bubo* are admitted, including *bengalensis* and *ascalaphus*, both of which have been considered full species by some authors. The latter form interbreeds with a race of *bubo* at the eastern end of its range, but overlaps (or formerly did so) another race at the western end. Although Vaurie does not specifically mention this point, *Bubo bubo* may thus be added to the list of species demonstrating an "overlapping circle" of subspecies. Three races of *B. africanus* are admitted, with *kollmanspergeri* Niethammer placed as a synonym of *cinerascens*.—K. C. P.

The short reviews in the Recent Literature section of The Auk, vols. 76 and 77, were contributed by the following persons (their identity being indicated in most instances by initials): P. H. Baldwin, F. G. Cooch, W. C. Dilger, S. T. Dillon, E. Eisenmann, J. W. Hardy, H. Howard, J. C. Howell, D. W. Johnston, S. C. Kendeigh, R. F. Labisky, F. McKinney, H. C. Mueller, M. T. Myres, R. W. Nero, K. C. Parkes, R. E. Phillips, R. T. Reuther, J. P. Rogers, H. C. Siebert, R. I. Smith, J. T. Tanner, M. A. Traylor, F. J. Turček, M. D. F. Udvardy, A. Wetmore.

NOTES AND NEWS

The American Institute of Biological Sciences is currently translating and publishing seven Russian research journals in biology. These journals are translated with support from the National Science Foundation, which is eager that such information be more widely distributed to biologists throughout the world.

The journals currently being translated are: Doklady: Biological Sciences Section; Doklady: Botanical Sciences Section; Doklady: Biochemistry Section; Plant Physiology; Microbiology; Soviet Soil Science; and Entomological Review.

In addition to its program of Russian biological journal translations, the AIBS has instituted a separate program of translation and publication of selected Russian monographs in biology.

It was felt that the program of journal translations was not sufficient to cover all of the significant work being done in all fields of biology by Russian scientists. With the aid of competent authorities, the AIBS has translated and published six Russian monographs and one monograph is in the process of being published. In addition, several prominent monographs in various biological areas are being considered by the AIBS and the National Science Foundation for translation and publication. The monographs that have been published are: Origins of Angiospermous Plants by A. L. Takhtajan; Problems in the Classification of Antagonists of Actinomycetes by G. F. Gauze; Marine Biology, Trudi Institute of Oceanology, Vol. XX, edited by B. N. Nikitin; Arachnoidea by A. A. Zakhvatkin; and Arachnida by B. I. Pomerantzev. The manuscript for Plants and X rays by L. P. Breslavets is in the final stages of preparation and should be published early in 1960.

Additional information pertaining to this program may be obtained by writing to the American Institute of Biological Sciences, 2000 P Street, N.W., Washington 6, D.C., U.S.A.

Information on the whereabouts of skins, bones, or other remains of the Carolina parakeet *(Conuropsis carolinensis)* will be appreciated. I am writing a monograph on this species and should particularly like information on private and small institutional collections. Hints on unpublished data or out-of-the-ordinary publications will be welcome. Address Daniel McKinley, Biology Department, Salem College, Winston-Salem, North Carolina.

J. M. Winterbottom became Director of the Percy Fitzpatrick Institute of African Ornithology on 1 September 1960. The offices of the Institute are now in a new and recently completed building on the campus of the University of Cape Town.

The Union has lost recently two of its most esteemed members. Mr. Wendell Taber, a member since 1933 and an elected member since 1948, died on 29 August 1960. On 16 September 1960 death came to Dr. Frederick C. Lincoln, a member since 1910 and a fellow since 1934.

OBITUARIES

On 2 December 1959 EDITH K. FREY, a life member of the A.O.U., passed away at the age of 83 years after a short illness. She was a constant source of inspiration to people interested in the out of doors, and was instrumental in starting several excellent ornithologists in their respective fields. She was one of the key figures in the establishment of the Kate Palmer bird sanctuary. She recently presented Michigan State University with a collection of South American bird skins, including uncommon tropical Tanagers and Hummingbirds.

Born in Jackson, Michigan, 12 October 1876, she was the oldest of six Krieger girls. She was married in 1905 to Frederick G. Frey, who died in 1919. Her enthusiasm for birds took her to Alaska in 1920, and to Nova Scotia in 1923. She joined the A.O.U. in 1923, and since that time she has missed only three annual meetings. Of interest to many long-time members of A.O.U. would be her scrapbook of programs and snapshots of many prominent living and recently deceased ornithologists.

In 1927 Dr. Alfred Gross invited her to join him at Barro Colorado in the Canal Zone. From there they continued on to Quayaquil and Quito, Ecuador, where they collected the birds that formed the basis of her collection, later donated to Michigan State University. She was much in demand by local clubs as a speaker on conservation.

In her later years her wild flowers and bird feeding stations brought her a constant dividend of interest and happiness. Before her fireplace she spent long evenings reading from her extensive natural history library. One of the real pleasures for many of us was to drop in to share Edith's fire, good food, sharp wit, and deep conviction of the need of an alert conservation-minded public.—ROBERT A. WHITING.

EVELYN VIDA BAXTER, L.L.D. (Glas.), M.B.E., F.R.S.E., and a Corresponding Fellow of the A.O.U., died at her home in Upper Largo, Fife, Scotland, on 1 October 1959. Miss Baxter and her life-long friend and companion, Miss L. J. Rintoul, contributed very extensively to Scottish ornithological literature and were active advisers and close personal friends of many students of Scottish birds. Among their contributions were: the editing of "Report on Scottish Ornithology" 1910–1928; "A Vertebrate Fauna of Firth" 1935; "The Birds of Scotland" 1953. Miss Baxter was a joint founder President of the Scottish Ornithological Club and was the first woman Vice-President of the British Ornithologists' Union, having been awarded the Union's Gold Medal at the Centenary Celebrations in 1959. (Condensed from British Birds, March 1960, pp. 125–127.)

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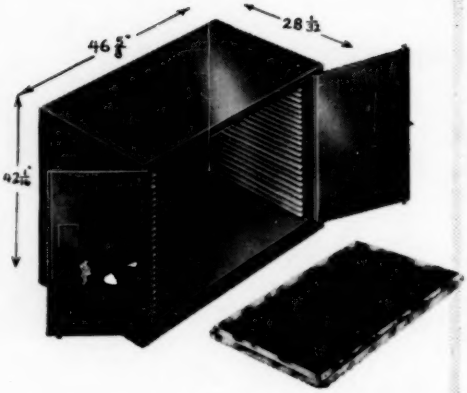
Compiled by L. R. WOLFE

(New generic, specific and subspecific names are printed in heavy face type.)



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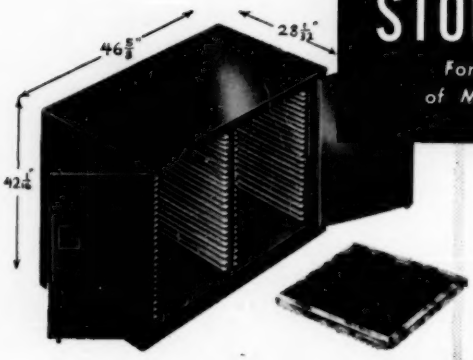

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